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POWER

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Recognition of the Engineer

WHO built the Hudson Tubes?

Not the new vehicular tunnel but the railed subway connecting Jersey City and Hoboken with uptown and downtown New York.

They are called the McAdoo Tubes—but who built them?

McAdoo was the man, and all honor to him for it, who saw the need and the opportunity and marshaled the means and got the job done. But who did it?

Future generations will not have to look up the answer when this question is asked with regard to the vehicular tunnels just opened between New York and New Jersey.

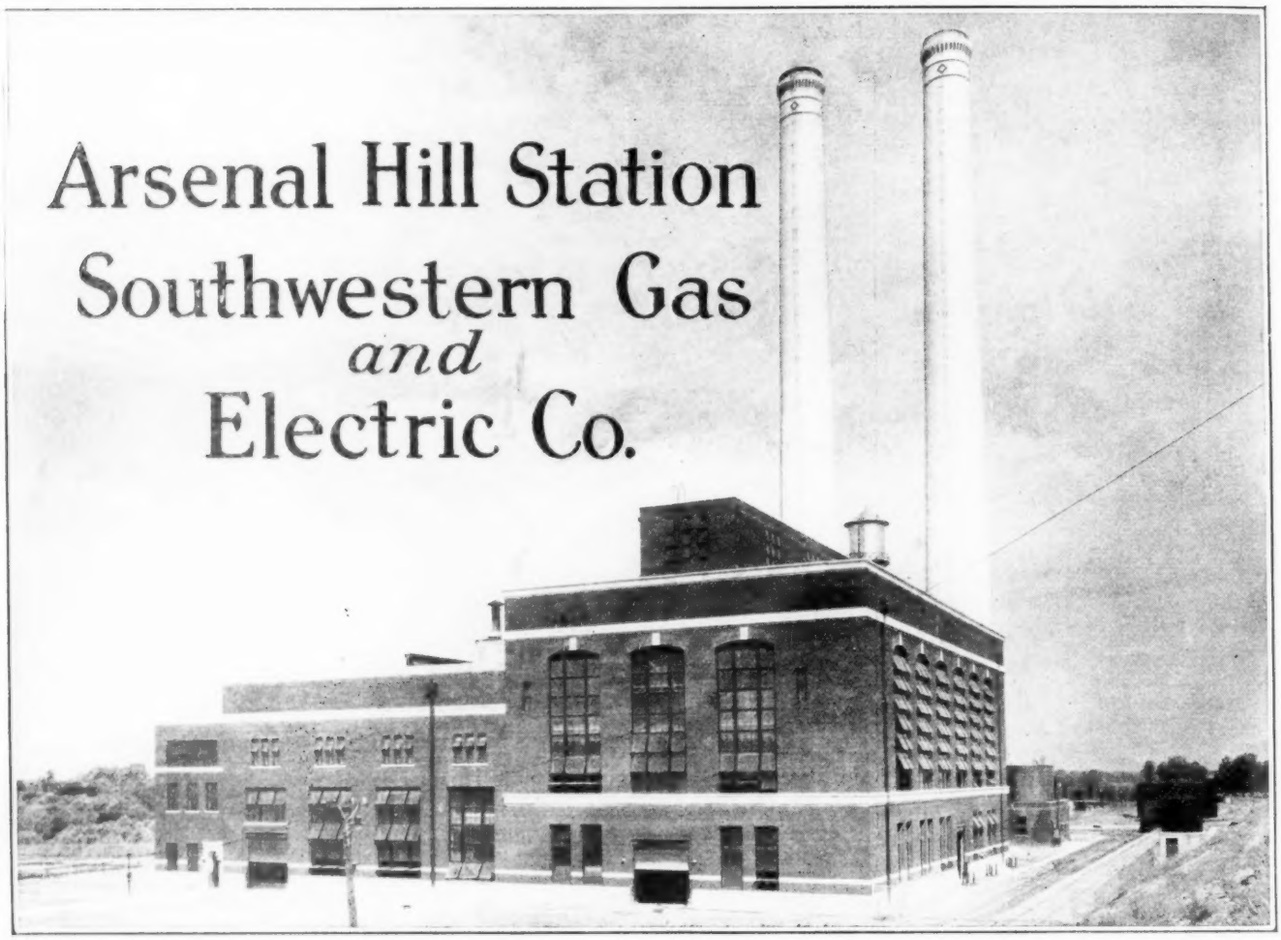
They are the Holland Tubes because Clifford M. Holland, Engineer, solved the problems connected with their design and construction.

And the approach on the New York side is called the Freeman Plaza because Milton H. Freeman, Engineer, took up the work after it had taken toll of Holland's life and used himself up in carrying it to completion.

The bestowal of these names and the generous recognition given to the engineers by the interstate commissions and those in charge of the opening ceremonies is unusual and I hope is inspired as much by a growing appreciation of the services of the engineer as by the fact that both of the engineers in question died at their task.

F. R. Low

Arsenal Hill Station Southwestern Gas *and* Electric Co.



THAT the agricultural South is retreating before the advance of industrialism is evident to those visiting the states below the Mason and Dixon Line. Nowhere are manufacturers springing up so rapidly as in those states bordering on the Mississippi River. There is a marked tendency to use purchased power, and to meet this demand in the territory served by its lines, the Southwestern Gas & Electric Company has completed a 30,000-kva. station at Shreveport, La. Although the present peak load does not exceed 15,000 kva., expectations are that the plant will be fully loaded in a few months. The new load will be made up of a number of factories now developing their own power and that part of the transmission line now being handled by the Marshall, Tex., and the Texarkana, Ark., power plants.

When the first section of the plant was put into service in 1926, it contained but one 10,000-kva. turbine and three box-header type water-tube boilers. Since then the Insull interests, who purchased the company from the Dawes interests, have installed two more 10,000-kva. turbines and three more boilers, the latter being of the crossdrum type. This additional machinery was put into service in February, 1927, although part of the plant was not completed until October.

The building, which appears in the headpiece, is built of red wire-cut brick with steel columns supporting the roof trusses. The turbine room and the offices are in the left half of the building while the boilers occupy the right half.

The turbine room has a red tile floor and the walls for a height of about eight feet are faced with a mottled green tile, the remainder being faced with a salmon-colored pressed brick. The three turbine-generators deliver current at 11,500 volts and, as shown in Fig. 1, the exciters are direct connected. No auxiliary exciter set or house turbine is installed. All the house service current is obtained at 2,300 volts from the main busbars through transformers and a secondary bus. The throwing into service of the water supply motor at a distant pumphouse causes the secondary bus voltage to drop sharply, but the transformers prevent the disturbance from reaching the main bus.

In the boiler room are six water-tube boilers of 11,800 sq.ft. each. The three installed with the first turbine are of the box-header horizontal-drum type, and the other three are of the cross-drum serpentine sectional header design. In designing the original installation the former owners of the company decided upon 275 lb. as the working pressures. When the Insull interests took charge, the same pressure was chosen for the new units.

All the boilers are fitted with convection-type superheaters designed to give 150 deg. superheat. It is the present intention to install radiant superheaters to operate in series with the convection-type units.

The first three boilers were fitted with combined gas and oil burners, since there was a danger of gas short-

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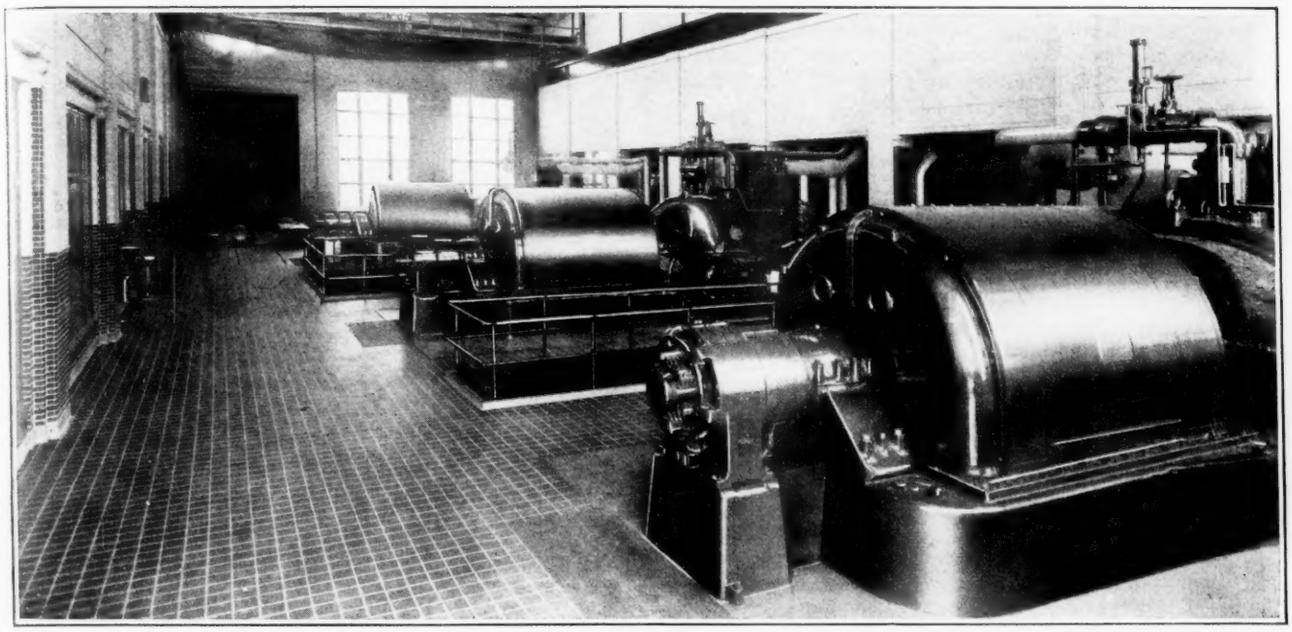

Fig. 1—Turbine room of Arsenal Hill Station

age due to line breakage. The crossdrum boilers have gas burners only. These are of the outside-mixing type. Gas and air enter the casing of a centrifugal blower which, after thoroughly mixing the two, delivers the air-gas mixture to the burner nozzles. Each boiler is served by two units, each consisting of two blowers, direct-connected to a motor. In addition, as shown in Fig. 3, an equal number of stand-by blowers are placed under the working units. The furnaces are lined with a good grade of firebrick, and in the last three boilers the side walls are built with air spaces for cooling. The air flowing down these spaces is used as a secondary supply to the burners.

A complete list of indicating and recording instruments

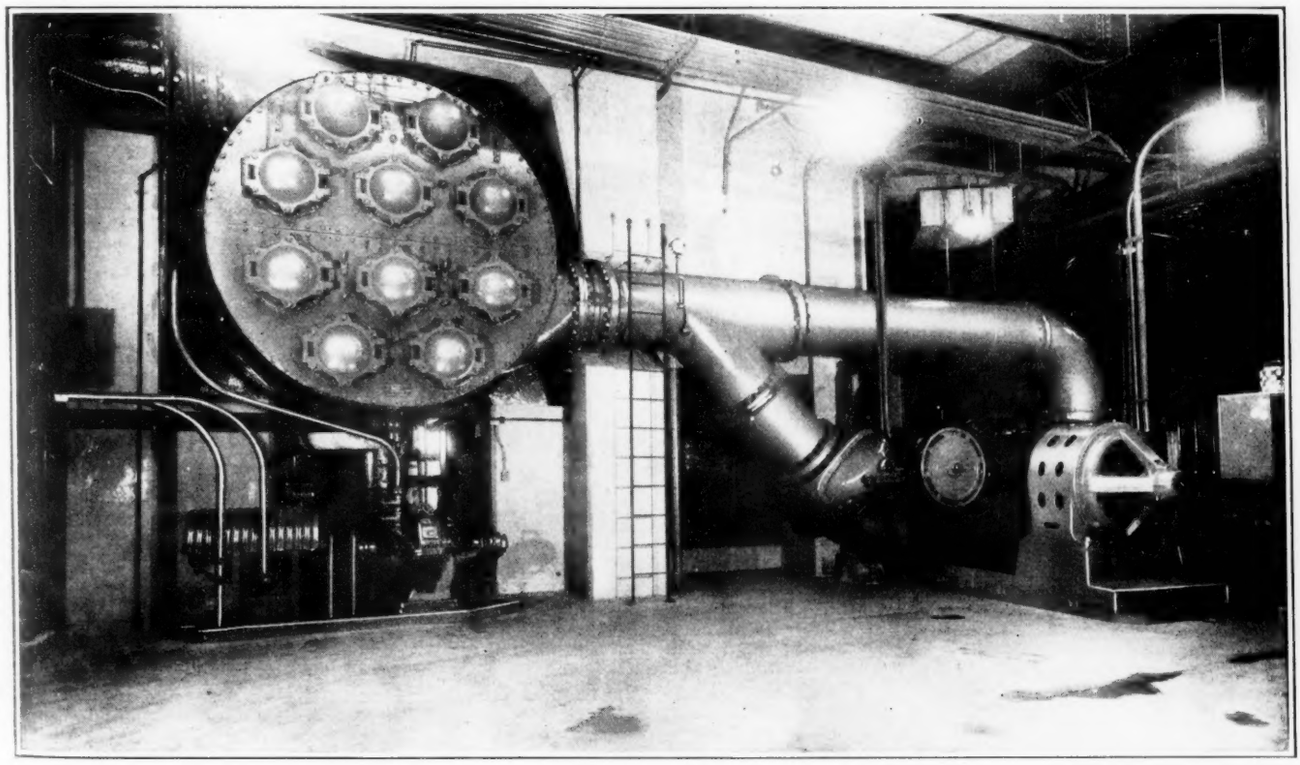

Fig. 2—One of the condensers with its auxiliaries

is mounted in front of each boiler. This includes a CO_2 indicator, a steam-flow meter, a flue-gas temperature recorder and a multi-pointer draft gage.

The steam lines to the turbines and the high-pressure extraction lines run to the turbine horizontally at a distance of ten feet from the floor level. Each of the live steam lines have but one bend, this being at the point where the line connects with the steam main in the boiler room; all other turns are made with flanged elbows.

Reinforced concrete piers reaching from the basement floor support the turbines with the condensers placed below. At each turbine is placed an instrument board which carries the electrical signal lights used by the load dispatcher to notify the watch engineer when the turbine is to go in or out of service. Included on this board are the instruments that are listed below, along with the observed readings.

Throttle steam pressure....	Indicating gage	260 lb.
First stage pressure.....	Indicating gage	65 lb.
High-pressure extraction ..	Indicating gage	12 lb.
Low-pressure extraction ..	Indicating gage, Vac. .	9.5 in.
Condenser vacuum	Indicating gage	29 in.
Condenser vacuum	Mercury column	
Turbine speed	Frequency indicator .	
Generator air temperature.	Duplex recorder { In ..	81 deg.
	{ Out	103 deg.
Throttle steam { pressure ...	Duplex recorder {	257 lb.
{ temperature	{	500 deg.
Condensate { from hotwell	Duplex recorder {	86 deg.
temperature { from 1-p. heater	{	163 deg.
Condensate from deaerator	Recorder.....	204 deg.

When the machinery was first installed, the cooling water for the generator air cooler was taken from the main water line and then forced through the turbine-oil cooler. However, the volume of the water was so great that the oil was chilled to too low a point. The water lines were rearranged, and at present the air-cooling water is taken from the condenser intake connection and, after being put through the cooling coils by a centrifugal pump, is discharged into the upper pass of the condenser. The water for the oil cooler is taken from the intake main and is wasted to the sewer.

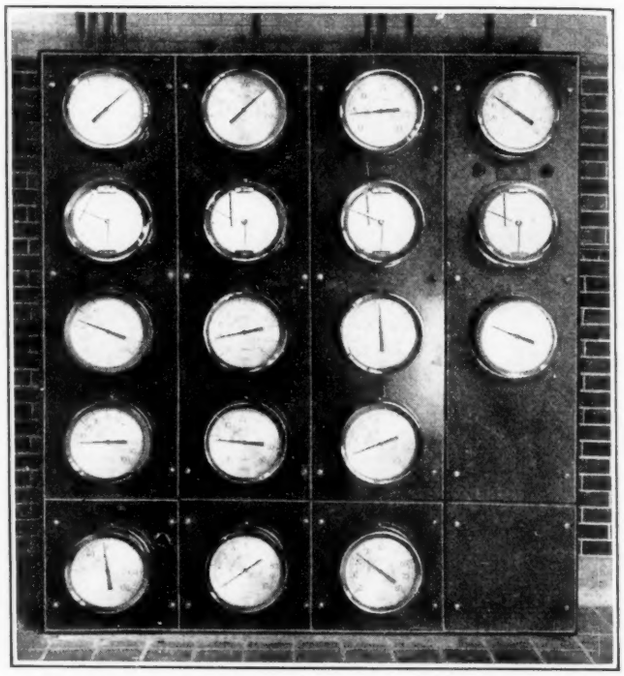

Fig. 4—Boiler control panel with indicating and recording instruments

Fig. 3—Firing aisle in boiler room

Below each turbine is placed a 17,500-sq.ft. surface condenser. When the plant was first designed, it was planned to use a spray cooling pond, taking its makeup from a near-by stream or bayou; and since but one turbine was to be installed, duplicate circulating pumps were chosen. On the first condenser, then, there are two 18-in. centrifugal pumps, direct-connected to 150-hp. motors. The two condensers installed with the last two turbines have but one 24-in. pump each.

It was discovered after the plant was put into service that the water coming from the bayou is cold enough save during a few days in summer when the water temperature goes above 90 deg. The spray pond is seldom used, and all the circulating water is taken from the bayou by one of two 17,500-g.p.m. pumps located in the pumphouse, about 1,000 ft. from the power house. These pumps can be started

from the power house, but the practice is for the engineer to visit the pumphouse hourly, and the controls at the pumps are used in starting and stopping a unit. The water main runs through the turbine-room basement in a pipe chaise to connect with the spray pond. The circulating pump suctions are connected to this line. When using the bayou water, the circulating pumps are bypassed, through the operation of motor-driven gate valves; the water then passes directly through the condensers and, entering the discharge line, flows to the river at a point about 1,000 ft. below the pumphouse. The fall of the bayou is sufficient to cause the circulating water to siphon

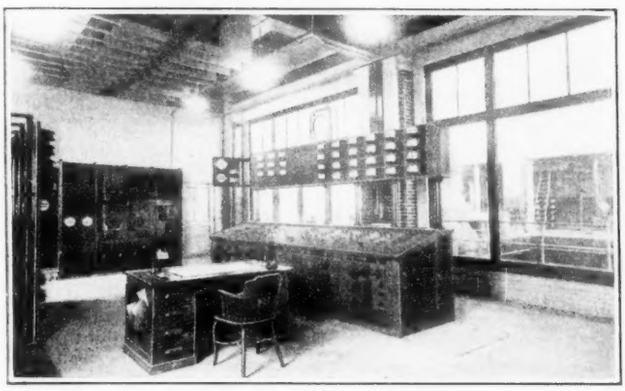

Fig. 5—Switchboard and control room

through the condensers. The discharge line also is extended to the spray pond, where it connects with the spray-nozzle system. By closing the necessary valves one of the condensers can be supplied from the spray pond while the other two use the bayou water.

The condenser of the first turbine installed has a motor-driven, rotative, dry vacuum pump, but the others have two-stage, steam-air ejectors with intercoolers and aftercoolers. These take steam from the 275-lb. header, but needle valves ahead of the nozzles reduce this pressure to 90 lb.

Although the condensers are opened regularly, it has been found that there is enough sand in the water to scour the tubes, so no washing or turbining is necessary.

As the makeup water carries much sediment and considerable scale-forming material, a double-effect evaporator was installed. Steam is supplied to the first-effect coils at about three pounds pressure from the turbine extraction line, that line being connected to the exhaust lines of the turbine-driven boiler feed pumps.

The condensate from the main turbine condensers is passed through the evaporator aftercondenser, where it condenses the vapor coming from the second effect. The evaporator-condenser condensate goes to the distilled-water makeup tank. The condensate from the first and second-effect coils goes to the evaporator condenser through traps.

The main condensate, after leaving the evaporator condenser, goes to the low-pressure heater, where it is heated by steam extracted from the turbine at 7-in. vacuum. The condensate from the low-pressure steam is put into the main condensate line just beyond the heater. The condensate then goes to the deaërator, which is supplied with steam from the 7-lb. high-pressure extraction lines. After deaëration, the water is dropped into the feed-water storage tank, which is immediately below the deaërator and on the boiler room floor behind one battery of boilers.

The distilled water from the evaporator, after going to the distilled-water tank, is lifted by a centrifugal pump and delivered to the makeup storage tank below the boiler room roof trusses. From this point it is supplied, as needed, to the feed-water storage tank. The evaporators and boiler feed pumps are in a recess adjacent to the turbine room and beneath the boiler room floor. Of the four feed pumps, two are 4-in., 4-stage centrifugals, direct-connected to 120-hp. back-pressure steam turbines, and two are 4-in., 5-stage units, direct-connected to 125-hp. motors. At present the motor-driven units are used exclusively, as the operating force has found that this gives a lower B.t.u. consumption per net kilowatt-hour at the switchboard.

Each of the four pumps has twin discharge lines; one of these lines goes to the regular boiler feed water loop, while the other is connected to an auxiliary or stand-by feed line.

In this alcove is placed a gage board carrying all the instruments pertaining to the feed water system. This board is shown in Fig. 4 and contains the instruments tabulated.

FEED WATER INSTRUMENT BOARD

2 Indicating gages	Steam pressure to auxiliary header
1 Indicating gage	Steam pressure to exhaust header
1 Indicating gage	Evaporator condenser shell pressure
1 Recording gage	Deaërator pressure
1 Temperature recorder	Evaporator feed temperature
1 Pressure recorder	Boiler makeup pressure
1 Pressure recorder	High-pressure gas
1 Indicating gage	Steam pressure to air ejector
1 Indicating gage	Evaporator condenser shell pressure
1 Indicating gage	Evaporator open heater pressure
1 Indicating gage	High-pressure gas
1 Indicating gage	Steam to first effect
1 Indicating gage	First-effect vapor pressure
1 Indicating gage	Second-effect vapor pressure
1 Recording gage	Service water header pressure
1 Indicating gage	Service water header pressure
1 Indicating level gage	Distilled water storage level
1 Indicating gage	Treated water pressure
1 Recording gage	Treated water pressure

It may seem strange that a plant of this capacity contains no economizer or air preheater. Natural gas, however, is obtained at a price so low that such apparatus are not economically justified. The possible gain from preheaters is not as great as in case of coal-fired boilers, owing to the lesser amounts of excess air. At the present time the flue-gas temperature ranges around 475 deg. F.

The boilers are connected in what might be termed an "open loop." A loop runs along one set of boilers with one end crossing over the aisle to connect with two of the other set and with the other end to connect to the third boiler of the second set. The lines for the turbine leave this loop at the bottom. In addition both ends of the auxiliary header are connected to the main header. Van Stone joints with gaskets are used on all the lines.

This station is an example of how the cost of fuel influences the design and first cost of the equipment. With cheap gas there was no incentive to go to high pressures, to install economizers, preheaters, combustion control or to use steam reheating.

PRINCIPAL MECHANICAL EQUIPMENT, IN ARSENAL HILL STATION SOUTHWESTERN GAS AND ELECTRIC COMPANY

BOILERS

Make	Springfield Boiler Co.
Type	Horizontal, crossdrum, drop-leg, water-tube
Number	3
Steam pressure, lb. gage	275
Steam temperature, deg. F.	564
Heating surface, sq.ft.	10,888
Superheaters	Superheater Co.
Soot blowers	Vulcan Soot Cleaner Co.
Furnace type	Air-cooled walls
Furnace volume, cu.ft.	6,000
Make	Heine Boiler Co.
Type	Horizontal, crossdrum, water-tube
Number	3
Steam pressure, lb. gage	275
Steam temperature, deg. F.	564
Heating surface, sq.ft.	10,822
Superheaters	Superheater Co.
Soot blowers	Vulcan Soot Cleaner Co.
Furnace type	Solid wall
Furnace volume, cu.ft.	5,125

COMBUSTION EQUIPMENT

Burners, for Springfield boilers-high-pressure comb. gas and oil	Webster Engineering Co.
Number per boiler	9
Burners, for Heine boilers, high-pressure comb. gas and oil	Maxon Furnace & Engineering Co.
Number per boiler	4
Gas regulators, 6, high-pressure	Chaplin-Fulton Manufacturing Co.

OIL HANDLING EQUIPMENT

Transfer pump, 1, rotary, motor-drive, 350 gal. per min. capacity	Kinney Manufacturing Co.
Oil storage tank, 10,000 bbl. cap.	Chicago Bridge & Iron Works
Auxiliary oil tank, 185 bbl. cap.	Chicago Bridge & Iron Works
Oil feed pumps, 2, duplex, steam driven, 6x4x6 in.	Worthington Pump & Machinery Corporation
Oil strainers:	
1, twin	Elliott Co.
2, single	Kinney Manufacturing Co.

AUXILIARY BOILER EQUIPMENT

Blowoff valves	Yarnall-Waring Co.
Non-return valves	Edward Valve & Manufacturing Co.
Safety valves for Springfield boilers	Consolidated-Ashcroft-Hancock Co.
Safety valves for Heine Boilers	Ashton Valve Co.
Water columns	Reliance Gauge Column Co.
Feed water regulators (S-C)	Swartwout Co.

BOILER FEED SYSTEM

Water purifying, We-Fu-Go system, capacity, 3,000 gal. per hr. installed, 9,000 gal. ultimate	W. B. Scaife & Co.
Pumps, 2, motor-driven, centrifugal, automatic control	Worthington Pump & Machinery Corporation
Open heater, cap. 9,000 lb. per hr.	Griscom-Russell Co.
Evaporators, 2, double-effect, capacity, 10,000 lb. per hr.	Griscom-Russell Co.
Feeders, 2, automatic	Griscom-Russell Co.
Vapor condensers, 2, 4-pass	Griscom-Russell Co.
Air ejectors, 2, 75 lb. pressure	Worthington Pump & Machinery Corporation
After condensers, 2	Griscom-Russell Co.
Feed pumps, 4, 4-stage, double suction, 300 g.p.m. against 330 lb. pressure; 2, turbine-drive, 2, motor-drive	Worthington Pump & Machinery Corporation
Excess press. regulators, 2, Mercon	D. H. Skeen & Co.

HEAT TRANSFER EQUIPMENT

Low-pressure heaters:	
Two	Elliott Co.
One	Griscom-Russell Co.
Deaerator, cap. 266,000 lb. per hr.	Griscom-Russell Co.

GENERATING EQUIPMENT

Turbines, 3, single cylinder, 9 stage extraction, 10,000 kw., 11,800 r.p.m. Initial pressure, 1300 lb. per sq.in., superheat 200 deg. F.	General Electric Co.

GENERATING EQUIPMENT—Concluded

Generators, 3, 12,500 kva.	General Electric Co.
Atmospheric relief valves, 3, 24 in.	Edward Valve & Manufacturing Co.
Exciter, 75-kw., 125-volt, direct connected	General Electric Co.
Oil purifier	De Laval Separator Co.

CONDENSING EQUIPMENT

Condensers, 3, horizontal, two-pass, surface, 17,500 sq.ft. each	Worthington Pump & Machinery Corporation
Condensate pumps, 6, 2-stage, centrifugal, 350 g.p.m., 160 ft. head, 1,200 r.p.m., motor-driven	Worthington Pump & Machinery Corporation
Vacuum pumps, 3, 24-in. double suction, single-stage, centrifugal, 16,800 g.p.m., 32 ft. head, 450 r.p.m., motor-driven	Worthington Pump & Machinery Corporation
Spray-pond pumps, 2, 24 in. and 2, 18 in. centrifugal, motor driven	Worthington Pump & Machinery Corporation

ELECTRICAL EQUIPMENT

Power and auxiliary transformers, 3, oil-cooled, 3-phase, 1,200 kva., 11,500 to 2,300 volts	General Electric Co.
Switchboard and accessories	General Electric Co.
High-potential switching equipment	General Electric Co.
Storage batteries for d.c. control	Electric Storage Battery Co.
Meters, relays and control devices	General Electric Co.
Outdoor switch tower	General Electric Co.
Wire and cables	Standard Underground Cable Co.
Automatic telephone system	Automatic Electric Co.

VALVES AND INSULATION

Motor-operated valves	Crane Co.
High-pressure valves	Crane Co., Edward Valve & Mfg. Co., Lunkenheimer Co.
High-pressure check valves	Crane Co.
Emergency trip throttle valves	Schutte & Koerting Co.
Standard valves	Crane Co., Lunkenheimer Co.
Pressure reducing valves	D. H. Skeen & Co.
Insulation	Johns-Manville (Inc.), Standard Asbestos Co.

INSTRUMENTS

Draft gages:	
3, multipointer	Hays Corporation
3, multipointer	Bailey Meter Co.
Pressure gages	Consolidated-Ashcroft-Hancock Co.
Gas flow meters, 6	Republic Flow Meters Co.
Feed water flow meters, 6	Republic Flow Meters Co.
CO_2-meters:	
1 chemical recorder	Republic Flow Meters Co.
3 Ranarex	Permutit Co.
Condensate meters, 3 Venturi	Builders Iron Foundry
Master gages, 2	Ashton Valve Co.
Indicating gages	Foxboro Co.
	Consolidated-Ashcroft-Hancock Co.
Recording gages	Foxboro Co.
Indicating thermometers	Taylor Instrument Co's.
	Precision Instrument Co.
Recording thermometers	Foxboro Co.
Mercury column vacuum gages	Taylor Instrument Co's.
Barometer	Precision Instrument Co.

MISCELLANEOUS

Breechings and air ducts	Connery & Co.
Gunite lining for smoke flues	Gunite Concrete & Construction Co.
Traveling water screens, 2	Link-Belt Co.
Water tank, 25,000-gal. capacity	Chicago Bridge & Iron Works
Overhead traveling crane, 50-ton	Whiting Corporation
Bilge and boiler feed makeup pumps, 7 vertical, motor-drive	Yeomans Bros.
Service water pumps, 3 centrifugal, 75-hp. motor drive	Worthington Pump & Machinery Corporation.
Air compressor 1, 13x14-in. Laidlaw, belted, motor drive	Worthington Pump & Machinery Corporation.
Steam traps	Crane Co.
Vacuum traps	V. D. Anderson Co.

Operating Boiler Plant *on a* Bonus System

By Arthur M. Miller

Favorable Results Obtained With Hand-Fired Horizontal Return-Tubular Boilers at Tennessee Plant

THE Tennessee Eastman Corporation, a subsidiary of Eastman Kodak Company, operates a wood carbonization plant at Kingsport, Tennessee. This plant has a boiler house equipped with six 2,000-sq.ft. hand-fired horizontal return-tubular boilers. Five are always in operation and they develop between 105 and 140 per cent of rating continuously, the average probably being about 115 per cent.

In general a horizontal return-tubular boiler plant of this character is not considered a particularly high-class installation, the result being that its operation is not nearly so carefully controlled as is the case with the modern water-tube boiler plant. It has been found,

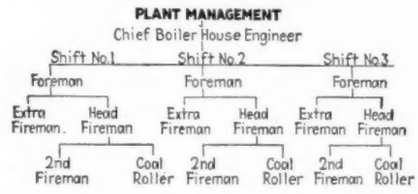

Fig. 1—Reorganization of boiler-house force

however, at this plant that excellent results can be obtained by proper operation of these boilers.

Boilers of this type, particularly if hand fired, depend to a great extent upon the human element for their performance. The supervision and the handling of the men are therefore important.

Inasmuch as the result depends so largely upon the human equation, it is reasonable to assume that a bonus system for the firemen would net good results. On this hypothesis the company decided to experiment with such a system.

After consideration of several plans and the trial of one or two, a bonus system was finally devised which has proved successful. The table shows the basis on which it went into effect last May. It has been amended in minor ways since its origin, but is now in use essentially as adopted.

The operating force in the boiler house is organized as shown in Fig. 1. The plant operates throughout 24 hours of the day and therefore requires three shifts, each shift being on duty for eight hours. All the firemen—that is, the head fireman, second fireman, coal roller and extra fireman—participate in the bonus plan.

As high evaporation per pound of coal is the goal, the backbone of this bonus system (see table) is based on the evaporation obtained per pound of coal during the period concerned. The other items that affect the bonus program are the maintenance of constant steam pressure, uniform water level, high feed-water temperature, and boiler-room cleanliness. Each item concerned in the bonus schedule is given a weight by percentage.

BONUS SCHEDULE

Evaporation...	10 lb.–72%	9.5 lb.–69.5%	9.0 lb.–67%	8.5 lb.–64.5%	8 lb.–62%
Pressure.....	19	19	19	19	19
Water level...	4	4	4	4	4
Feed water temperature	2	2	2	2	2
Cleanliness...	3	3	3	3	3
Total.....	100%	97.5%	95%	92.5%	90%

1. The evaporation will be the apparent water evaporated.
2. The water evaporated will be determined by the Venturimeter readings on the feed water.
3. The coal used will be determined by the difference in coal pile inventories over the period concerned, as submitted by the engineering department.
4. The rate of evaporation will not be determined for each shift, but the average rate for the total operating period will be used to determine percentage and this percentage credited to each shift.
5. The boiler plant chief engineer will make the evaporation determinations.
6. Each shift will be rated separately on steam pressure, water level, feed-water temperature and cleanliness. They will be rated by the chief engineer, who will be influenced by the recommendation of the shift foreman.
7. Steam pressure must always be kept between the bogy lines shown on the chart of the recording steam pressure gage. Each time the pressure gets outside of these lines, one demerit is charged to the shift concerned, and it loses thereby one of the total 19 per cent allowed for steam pressure.
8. The water level must be kept at the bogy mark on the water glasses. Whenever a high- or low-water gage whistle blows, the shift on duty receives a demerit and loses thereby one of the 4 per cent allowed for water-level.
9. The feed-water temperature must be kept above the bogy line on the chart. Each time it falls below the bogy temperature, the shift on duty receives a demerit, thereby losing one of the 2 per cent allowed for feed-water temperature.
10. The boiler plant must be kept clean. It is inspected daily and when not up to standard the shift concerned loses a percentage of the 3 per cent allowed for cleanliness.
11. The daily bonus schedule ratings will be made by the chief engineer, assisted by the shift foreman, and they will be posted.
12. The bonus will be based on monthly operation. To participate in it, the shift concerned must have earned a total of 90 per cent or better on the bonus schedule.
13. The four firemen only on each shift will participate in the bonus on the following basis: Whenever a shift earns 100 per cent in a month on the bonus schedule, the hourly rate of all the firemen on that shift will be increased for the month as follows: Head fireman, 3¼c.; second fireman, 2¾c.; third fireman, 2¼c.; extra fireman, 2¼c. If a shift earns between 90 and 100 per cent on the bonus schedule in a month, it receives that percentage of the total bonus as listed above.
14. The bonus checks will be issued monthly separate from the base pay checks.
15. This bonus plan does not change the existing rates of the firemen.

In the case of evaporation this percentage varies with the amount of evaporation. For instance, if 8 lb. of water per pound of coal has been evaporated, the weight of this item is 62 per cent. On the other hand, if 10 lb. of water had been evaporated per pound of coal, the

weight of this item would have been 72 per cent. The weight by percentage of the other items is constant; that is, steam pressure has a weight of 19 per cent, water level 4 per cent, feed-water temperature 2 per cent and boiler-room cleanliness 3 per cent.

Evaporation is determined by dividing the total amount of water fed to the boilers during the month as read from an integrating Venturi meter, by the total pounds of coal fed to the boilers during the month. The latter is found by subtraction of coal inventories taken the first and last of the month by surveying instruments; that is, by sectioning the coal pile and calculating its volume and therefrom its weight.

Of course the Venturi meter reading for feed water is not strictly representative of the total amount of water evaporated, as it does not take account of blowoff water, quality of steam or temperature of feed water. Nevertheless, it approximates the amount of evaporation closely enough so that the figure is satisfactory for this purpose. Furthermore, the measurement of the coal in the pile as it is done by surveyors cannot be strictly accurate, but it is not feasible to weigh the coal and this method suffices. Some months the figure is obviously not exactly correct, but it does average up reasonably accurate from month to month and gives satisfactory results.

It is not convenient to determine the evaporation obtained by each individual shift, hence the monthly determination of the evaporation percentage is credited to each shift alike. The record of each shift in other respects is kept separately on a chart as is shown by Fig. 2. This chart is posted in the boiler room and receives entries, if required, every day. Whenever a square has been blocked off, the shift concerned had a demerit of 1 per cent. It will be observed that the "Cook" shift did not have a demerit for the month, while the "Campbell" shift had only one, its demerit being for not properly maintaining the water level in the boilers. The "Jones" shift, during this same period, had a great many troubles, eight demerits in all. The six blocked-off spaces under "Water Level" indicate that six times during the month this shift did not maintain the proper water levels. Once the proper feed-water temperature was not maintained, and once the boiler room was not sufficiently clean. During August the apparent evaporation was 8½ lb., so for this evaporation each shift received credit of 64½ per cent. In addition the "Cook" shift received all the other allowable credits, giving them a total for the month of 92½ per cent. The "Campbell" shift had a total percentage for the month of 91½ per cent, while the "Jones" shift had the low percentage of 84½ per cent because of the deduction of 8 per cent for demerits. The "Cook" shift, therefore, received for the month of August 92½ per cent of the full bonus premium, while the "Campbell" shift received 91½ per cent of it. As no bonus is paid for operation totaling less than 90 per cent, the "Jones" shift received no bonus whatever for this month.

The monthly evaporation for the first six months of this year was as follows:

Jan.	9.15	lb. per lb. of coal
Feb.	8.40	lb. per lb. of coal
March	10.80*	lb. per lb. of coal
April	7.26	lb. per lb. of coal
May	9.30	lb. per lb. of coal
June	8.28	lb. per lb. of coal
Average	8.86	lb. per lb. of coal

*Error in coal inventory. Note that it was corrected by resulting lower evaporation the next month. A bonus adjustment was made so that the men would not suffer owing to this circumstance.

The evaporation is figured by the boiler-house chief engineer. The ratings on pressure, water level, feed-water temperature and cleanliness are also made by him, but he is influenced to a great extent by the foreman's judgment. Unfortunately, as yet no means has been worked out whereby the foreman himself can participate in the bonus. This is rather a difficult thing to accomplish because he must be depended upon to rate his men under this bonus scheme and his participation might influence his opinions.

DAILY BONUS RECORD—AUGUST 1927

Date	COOK SHIFT				CAMPBELL SHIFT				JONES SHIFT			
	Steam Pressure	Water Level	Water Temperature	Clean-liness	Steam Pressure	Water Level	Water Temperature	Clean-liness	Steam Pressure	Water Level	Water Temperature	Clean-liness
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
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31												

Fig. 2—This bonus record is duplicated in the boiler room

When the evaporation falls to 8 lb. of water per pound of coal, the total of the percentages will show only a 90 per cent operation. The firemen can participate in the bonus only if their operation has exceeded 90 per cent. In the event of 100 per cent operation the hourly rate of each fireman would be increased during the period concerned in the amount listed at the bottom of the schedule of the table; that is, the head fireman would receive 3¼c. more per hour than would otherwise have been the case. It seemed reasonable to graduate this bonus scale, thereby allowing the head fireman a slightly larger bonus than the second fireman, and so on throughout the list. In the event that the operation has been on a 95 per cent basis, the firemen will receive 95 per cent of the total increase per hour as shown on the schedule. In this case the head fireman would receive an increase of 95 per cent of 3¼c. per hour, or about 3 1/10c. per hour.

It is not the amount of this bonus that makes it worth

while, as the maximum that one of the foremen can obtain under its provision is an increment in wages amounting to about $8 a month. This is, nevertheless, a larger percentage of his pay check than would be the case in a northern plant where labor rates are comparatively high. The bonus is a real incentive despite the fact that it is not large. It incites competition between shifts and among the men of one shift. On a recent occasion one shift did not receive a bonus for two months in succession, while the two other shifts did receive a bonus. This caused the demotion of the head fireman on the shift that had been failing. As a result of a new man assigned as head fireman, the shift concerned climbed up to a bonus standing the next month. The plan, therefore, checks up on the ability of the firemen, particularly the head fireman.

In general, the conditions in the boiler house are better when the men are striving to make the grade on a bonus plan such as this. The plant is kept cleaner, the boilers are more carefully watched, the evaporation is better, and the whole operation seems to be in more healthy conditions.

Other Means of Attaining Efficiency

A bonus plan in the boiler house of the Tennessee Eastman Corporation is not the only feature incorporated to keep the steam production on an efficient basis. The whole operation is worked out on a definite schedule, and

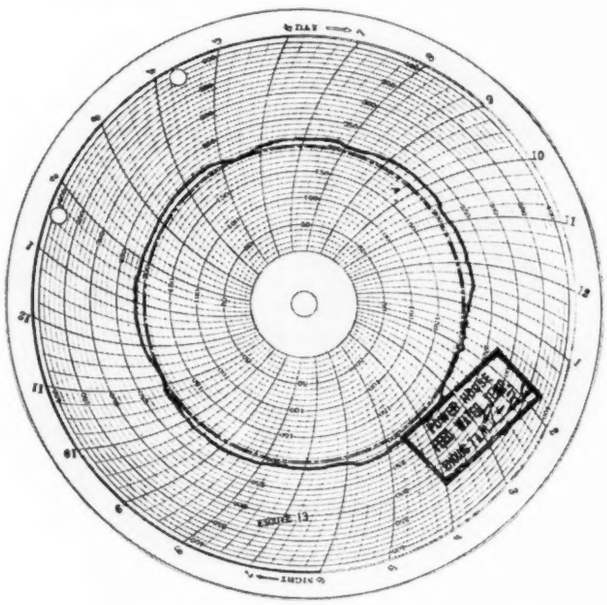


Fig. 3—The feed-water temperature is maintained nearly constant

the men are kept on their toes every minute to fulfill their duties. The plan of operation is as follows:

The shifts rotate every two weeks. The head fireman and the second fireman actually do the firing. The coal roller provides the coal, cleans the fires, removes the ash, and blows the flues, and the foreman and the extra fireman care for all maintenance, including overhauling of furnaces and the thorough cleaning of boilers when they are down.

As each shift comes on duty, the fires are cleaned, the flues blown, and after about four hours, the boilers are blown off. This is done by schedule on every shift. Blowing of the flues requires not more than five minutes per boiler so that the cooling action resulting from opening of doors is not particularly detrimental. The blowing down of the boilers is actually done by the foreman. There is no incentive, therefore, for one of the men on the bonus schedule to blow off an undue amount of water to increase the apparent evaporation.

Between 25 and 75 per cent of the feed water is re

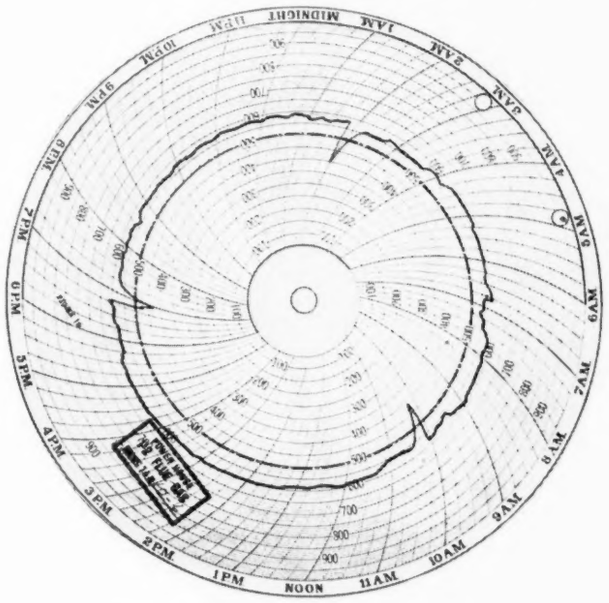


Fig. 4—Showing stack temperatures

turned process water, the amount depending upon the units in the plant that are in operation. This water is hot, and by careful control of it and attention to the makeup water the feed water is maintained at a fairly high temperature. A typical chart showing feed-water temperature is shown by Fig. 3. Incidentally, it has been found to be a good plan to admit the makeup water into the hotwell through open sprinkler heads. As the hotwell is open, the spray resulting from this cold feed water prevents any exhaust steam that may return with the hot water from escaping by blanketing it. This is also helpful at a time when there is a blowing trap on the return line or some other irregularity permitting low-pressure steam rather than hot water to get into the heater.

How the Boilers Are Cleaned

Once about every two weeks one boiler is taken out of service for thorough cleaning. This is done by the foreman and the extra fireman. The minimum length of time this boiler is out of service is about 30 hours. The cleaning procedure is as follows:

1. Trim the slag out of the furnaces.
2. Trim the slag off the bridge wall.
3. Wet the dust in the combustion chamber and remove it.
4. Let the water out of the boiler and wash it thoroughly by turning into it a fire-hose stream under high pressure.
5. Rattle the tubes thoroughly.
6. The extra fireman goes into the boiler and pokes the loose scale out from between tubes and removes all other

scale. He looks over the boiler and in particular examines the feed line.

7. The boiler is again washed out with high-pressure water.

8. Required furnace and grate repairs are made.

The boilers go out of service for cleaning on a regular schedule unless some emergency makes it necessary to take one out of service at another time. In such an event a return is immediately made to the regular schedule as soon as this boiler can be put back into service. As only five boilers are kept operating out of the six, the cleaning is seldom crowded.

As the boilers operate most of the time considerably above their rating, it is usually unnecessary to do anything but open the stack dampers wide. The only time

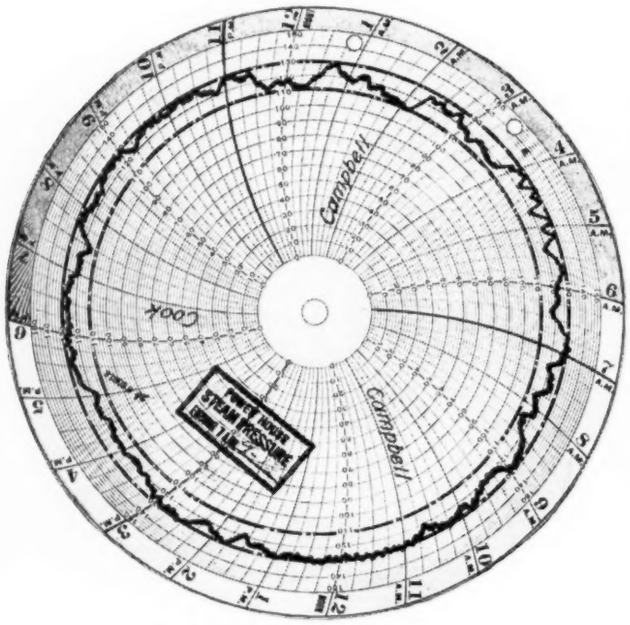


Fig. 5—Chart for steam pressure

they are even partly closed is in the event of a boiler popping. From the typical stack-gas temperature chart, Fig. 4, an idea may be obtained as to the condition of the stacks. The main function of these charts is to indicate when a boiler needs to be cleaned.

Whistles Indicate Water Level

In order to keep track of the water levels, high- and low-water whistles are installed on each boiler. These can be heard all over the plant, and for this reason and because of the bonus system the firemen are usually careful to prevent these whistles blowing.

The feed-water temperature is watched by means of a recording thermometer. One of the charts from this thermometer, showing the success with which the feed water is kept hot, is shown by Fig. 3.

A recording steam pressure gage has been installed, a typical chart from which is shown in Fig. 5. Note the lines on this chart within which the pressure is to be kept. It is necessary for the fireman to keep the pressure within these lines in order not to receive steam-pressure demerits on the bonus system.

It will be noted that a bogy line is shown on all our charts, whether they be for steam pressure, feed-water temperature or stack-gas temperature. This gives the firemen something definite at which to shoot.

This horizontal return-tubular boiler plant is successful, and it is evident from the evaporation obtained that the study given its operation is worth while. The apparent evaporation, as worked out for use in the bonus computation, varies between 8 and 9½ lb. of water per pound of coal and will probably average about 8¾. For hand-fired furnaces equipped with only hand shaking grates, this seems to be good performance. These results cannot be attributed entirely to the bonus system, but unquestionably the bonus is responsible for a large share of the success of this operation.

Heat Prostration as An Accident

By Arthur L. H. Street

A FIREMAN employed by a cotton oil company was overcome by heat while at work and died four days later. Controversy arose between his widow and the employer whether or not the death resulted from an "accident" arising out of and in the course of the employment, within the meaning of the Tennessee Workmen's Compensation Act.

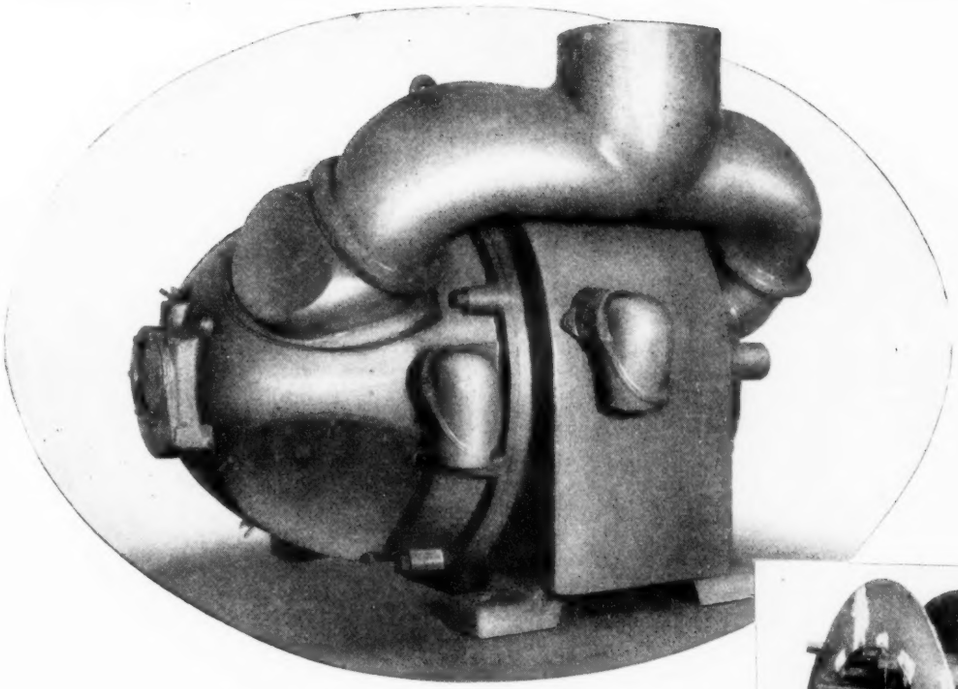
The Tennessee Supreme Court decided (King vs. Buckeye Cotton Oil Company, 296 South Western Reporter, 3) that the case did fall within the terms of the Compensation Act, if the employer had as many as five employees in its service at the time of the occurrence. The court finds from an examination of the decisions of courts of last resort in other states that there is a hopeless conflict in judicial views as to whether injuries of this kind can be said to be "accidents." But the court says:

"If the workman, overheated to a degree short of prostration or exhaustion, had stepped outside the boiler room, and, cooling off too quickly, had contracted a cold, resulting in pneumonia, no element of accident or injury by accident would have been present.

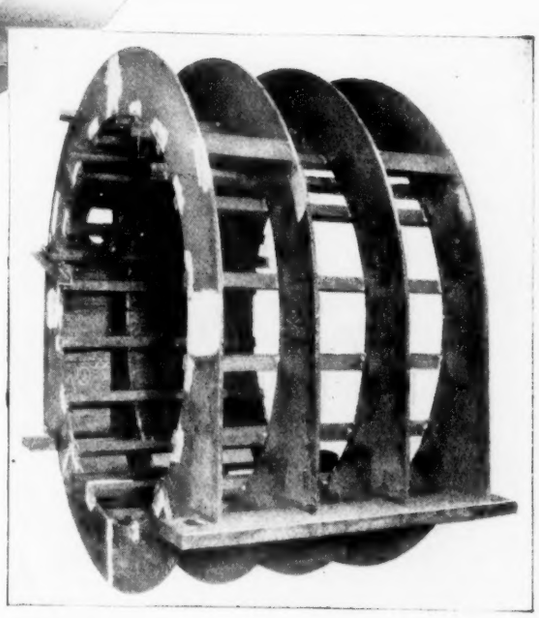
Prostration Not a Necessary Accident in Boiler Room

"Or if a fireman, by reason of his daily exposure to the increased heat of a boiler room, should become gradually impaired in strength and in his powers of resistance, and should thereby become subject to a disease," it would not be a compensable accident.

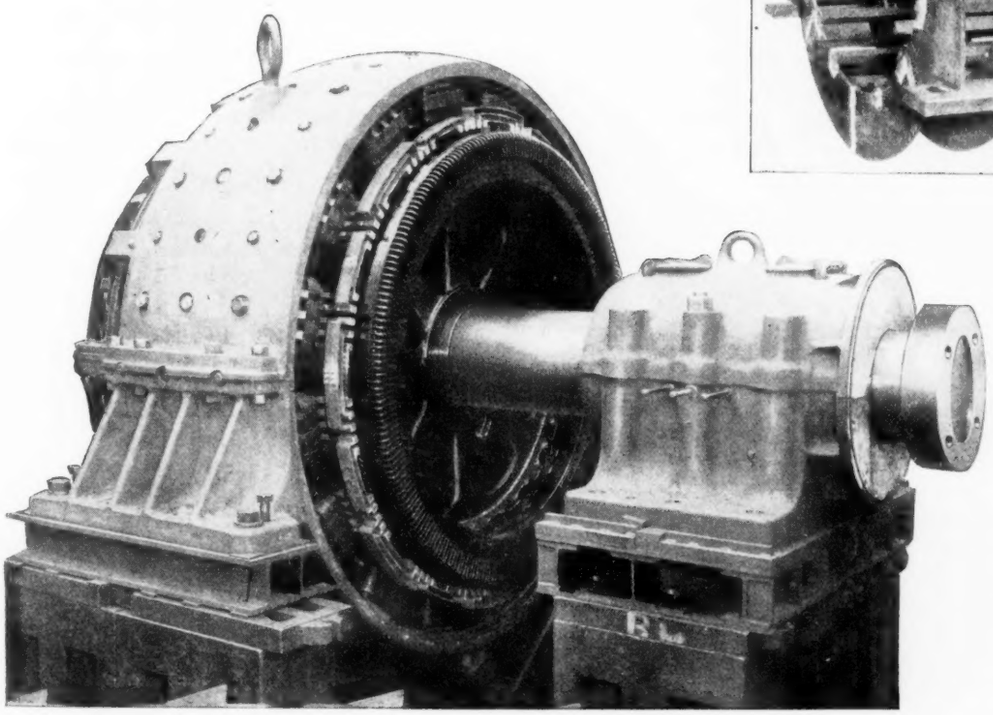
"We do not think, however, that heat exhaustion or heat prostration can be said to be a necessary incident or an unexpected result of employment as a fireman in a boiler room. Whether the condition be caused solely and entirely by the excessive temperature of the room or place in which the employee is at work, or whether the excessive temperature of the place and the present physical condition of the workman combine to produce the result, there is an element of sudden, unforseeen and unexpected casualty and misfortune in the result. The fireman expected to become hot, but he did not expect to become overheated to the point of exhaustion or prostration. The difference may be one only of degree, but we see no reason why such a difference may not mark the boundary between the expected or anticipated and the unexpected or fortuitous. Certainly it marked the boundary, in the case of the deceased workman, between safety and misfortune."



Left — Totally inclosed forced-ventilated motor rated at 300 hp. Without ventilation this motor would be good for a 30-hp. load only.



Right—Stator frame for a 7,500-kva. synchronous condenser. Only the bearing pedestals on this machine will be cast. All the rest of the structure, stator and rotor, is of electric welded steel plates and shapes.



Left—Steel-mill direct-current reversing motor without a bedplate, rated at 3,000 hp. This motor will operate at speeds from 65 to 130 and is the first reversing steel-mill motor to be supplied from a synchronous-motor generator set.

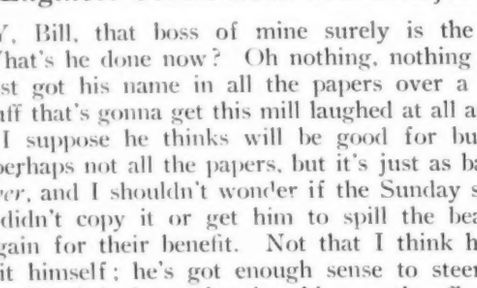
Photos by courtesy of the Westinghouse Electric & Manufacturing Company

Modernization vs. Executive Resistance—I

The Engineer Comes Back with a Rejoinder

SAY, Bill, that boss of mine surely is the limit. What's he done now? Oh nothing, nothing at all, just got his name in all the papers over a lot of fool stuff that's gonna get this mill laughed at all around, which I suppose he thinks will be good for business. Well, perhaps not all the papers, but it's just as bad, it's in *Power*, and I shouldn't wonder if the Sunday supplements didn't copy it or get him to spill the beans all over again for their benefit. Not that I think he ever wrote it himself; he's got enough sense to steer clear of that, but he's been shooting his mouth off at one of these Elks meetings and you know what they are.

What I'm getting at, I'm not taking any notice of what that article says and if the boss thinks he's gonna stop me rooting for a real honest-to-goodness up-to-date



"If the Boss thinks he's gonna stop me rooting for a real honest-to-goodness up-to-date power plant, he's all wet"

power plant, he's all wet, and if he thinks any spiel about firing me (yeh, he said that) is gonna get my goat, well he ain't right, that's all. He knows and I know, and he knows I know he knows—hell, I'm getting all mixed—anyway he won't do it. And why? Because he also knows right down inside him that he's got to get in line sooner or later or his business is gonna get out of line, and after all he's a little too smart to let it get down to that point. If I didn't think that, I wouldn't have stuck here so long. You know that job I could have got with the public utility people last year? Well, that would be a darn sight more comfortable and a little more money even just at first—yes, I know public utilities have the reputation of not paying big salaries, but that ain't always true. Anyway I was saying I wouldn't take it, because after all, if a fellow wants to get something for himself these days, he wants to hunt up the hard jobs, not the easy ones, and I figure there's a better prospect just now for a man who gets prepared for the change that's coming and roots for the high-pressure stuff than in any other grade of engineering.

Also, I've got a hunch that old Bliman isn't really as hard-boiled as he lets on to be. He's got his eyes open as well as some of us wise birds, and I guess he knows that a little opposition often brings out points that an easy-going agreement leaves buried.

So that's what I'm gonna do—keep rubbing it in. And between friends, I've been doing some rubbing in the past week or two. You saw that list of industrial plants in *Power* the other week that have gone over to high pressures and byproduct power generation? Yes, Bill, that's only a beginning, but it's a pretty hefty beginning, and when the first breech is made in a dam, the tide of waters pretty rapidly enlarges it. Besides, I happen to know for a fact that for every plant listed there are several others that have similar schemes already under way, and almost all of the industries using process steam and requiring power, like the paper and pulp, artificial silk plants and so on, are wide awake to what is going on. Well, what's going to happen? When all the mills have got down to the point of getting their power as a by-product and are making their economies as a result, prices will automatically fall and they will all be on an even footing again, but the wise ones who get in while the getting's good will have paid for their plant in savings and then some, while those who hang behind will be forced in at the end or be put out of business.

Well, talking of rubbing it in, I took that article to old Bliman the other day and, believe me, he knew all about it already, though he didn't say so; but I saw *Power* on his table under some papers, and I could tell by his manner it was nothing fresh to him.

Of course he was not encouraging, and he got me hot under the collar as usual, what with having to be polite and yet feeling that he didn't believe what he said himself.

"You've Gotta Use Tact"

Yeh, I was polite all right, you've gotta use tact in my position, though I did mention that anyone who couldn't see that high economy plants were bound to come, was in a state where he'd better run if he saw two doctors coming to talk to him. No, I don't think he saw the point.

Anyway what he said was: "Well, Jim, that's a list of maybe a dozen plants that have laid out their good money or maybe their stockholders' good money in a gamble. Now I could show you a list of a hundred dozen plants that have not done so. The majority wins, don't it?"

I got so mad I could of blown up, and that's when I made that wise crack about the doctors. He didn't take any notice and went on to say he could tell me of three mills in this district that had been generating their own power and had gone over to the public utilities in the last six months. "Which are they?" says I, though I knew. When he told me, I pointed out to him that two of them were cotton mills and one a machine shop, and that on this account none of them had much use for process steam. I figured that in cases like that the best thing they can do is to go to the public utilities and get service, and every luck to them. They are a fine lot of engineers, the finest in the world, and I've every respect for them, but where you've got to have process steam anyway, why not use the power you can get almost free? The public utilities can't help but throw away nearly three-quarters of their coal into their condensing water, and it's all got to be paid for just the same. If they ever come to a point where they can use their

*This is the first of a series of five articles written in the lighter vein inspired by, and providing a sequel to, an article which appeared in *Power*, May 10, of last year under title "Why I am not going to Modernize My Plant."

process steam like we can, why it's goodby private plants, but that time ain't come yet by a long way.

Of course, I understand the way he feels about it. It's his own money he's got to spend, and when a man's spending his own cash, he's gonna be mighty careful he sees his way to get it back, and I don't blame him; I'd be the same myself.

I was feeling a bit better when I thought about this and then he upsets me again. "You see, Jim, it's to your own interest to make this experiment at someone else's expense, ain't it?" he says.

The old man gives such darn fool answers that don't mean nothing, and yet I can't always answer them straight off. That's the way with arguments like that; they sound all right and you can't always spot the right answer quick, and so they get away with them. It's just like these politicians arguing about prohibition. Listen to any one of them on either side, and they sound fine and you've got to hand it to them for being right, but as soon as you hear the other side you get all mixed up.

Anyway, I got in the last word. I says: "Well, Mr. Bliman, interest or no interest, I want to see this mill capturing more business and getting bigger dividends, and I'm gonna rub it in till you see the light."

"A Little Humor Now and Then, Is Relished by the Best of Men"

THE following letters have been sent to *Power* by F. Gannett, of Gannett, Seelye & Fleming, Engineers, Harrisburg, Pa., and represent correspondence between the manager of one of their subsidiary companies and one of their engineers.

Dear Mr. Smith:

We wish to call your attention to an item of economy in our plant operation of ice production. Understand it is not that we operators wish the credit, for the credit is due the machine, and not us.

The item in question is this: We have operated our 7½x7½ York Single-Acting Two-Cylinder Ammonia Compressor twenty-four hours per day for two solid months . . . and have not used one pint of oil in the compressor. That sounds impossible, but the proof is here, for all to see. Do you know of a record that will equal this? Another thing; this machine is in its fifth year of service and making more ice than ever before . . . with no replacements up to date.

We recently had a visit from a lubricating oil salesman who told us he could lower our consumption on this machine. We asked him how he could do it when we were using *no oil at all now.*

We are justly proud of our little plant and have reason to be, as the above is no surprise to us.

Yours very truly,

R. A. Brown, Mgr.

Dear Mr. Brown:

We are in receipt of your letter concerning the small amount of oil consumed by your 7½x7½-in. York ammonia compressor. You have certainly established a fine record by operating this compressor 24 hours per day for two solid months without adding any lubricating oil.

We are wondering if you have tried taking off the belt to note whether the machine would operate without any motive power. As we see it, this is all that is necessary for you to have a perpetual motion machine. As soon as your compressor has this one added feature, we would advise you to get in touch with Washington immediately, as patents for perpetual motion machines are available and your future will be made.

Be that as it may, we want to congratulate you for the fine record you are making at Kirbyville. Keep up the good work.

Very truly yours,

E. C. Smith.

Dear Mr. Smith:

On receipt of your letter suggesting that we possibly had in our possession a potential perpetual motion ammonia compressor, we immediately held a council of war and decided to try out the suggestion. We stopped the machine and removed the belt, however, unthinkingly failed to properly "chock" the flywheel, to prevent its rotating. Therein we failed, and this failure was the cause of grief mentioned hereafter. The moment the belt was removed the compressor gained in speed, to such an extent that the frictional or static electricity thus generated promptly reversed the polarity of our generators, caused the generators to motorize, thus operating the driving engines as pumps. At the same time the current thus generated and disconcerted by the compressor at its abnormal speed reached such a potential that the tops of the poles on which the distribution is carried became incandescent, thus causing an alarm to be sent to the local Forest Patrol that the woods around here were burning.

About this time we noticed an abnormal chilling of the air, and on investigating, found that the two oil engines, being now operated as pumps, as the generators were "motorizing," were doing such excellent refrigerating that the entire country was rapidly becoming cooled. In a short time darkness seemed to be descending and the people began to clamor for lights. The only thing left for us to do was to suggest that they take advantage of the light from the pole tips, and thus set in use a new "white way" for the city government. At last, when conditions had become intolerable and people were dying by the thousands, the sun had taken on a frosty ring around its edge, and our poles were beginning to show signs of burning to the ground, someone, realizing that a crisis was nearing and having tried every other way known to baseball science of stopping this wildly racing compressor and still having no effect, suggested the final plan of attack. This consisted of placing a bucket of oil near the base of the machine, where the air suction caused a fine spray to settle on the machine. At the first touch of the oil, the compressor started to slow down, and stopped completely when two drops were poured on top of the cylinders. To prevent such an occurrence again, we are putting in the machine once every month, ten drops of oil. At present, so that you may know results of our experiment, promptly, we are writing this on the inside of our office safe, with all doors closed, and a candle for light. Without a serious delay we expect to have the temperature about normal in the surrounding country at the end of the month. Until then we must needs confine our messages of Peace on Earth and Good Will Toward Men to a few words, and far between times at that.

Assuring you that we live and learn and hope that we may continue to do so, and that we thank you very sin-

cerely for your good wishes and many courtesies shown us, and that we willingly try anything once or twice, we are, with all best wishes,

Yours very truly,

R. A. BROWN AND CREW.

P. S.: "Believe us" if the thermometers are correct, the "temperature" is once more *normal* and then some.

R. A. B.

Eye Hazards at Work and at Play—How to Guard Against Them

BY LOUIS RESNICK*

THE eye is a more delicate and more complicated mechanism than the finest watch in the world. The best watch can be bought for a few weeks' pay—a human eye that will see cannot be bought for all the money in the world, and yet thousands of men and women every day expose their eyes to hazards of flying particles to which they would not think of exposing the inner mechanism of a watch.

There is no such thing as a non-hazardous industry so far as eye injuries are concerned. Wherever men and women are employed, there is bound to be the danger of flying particles of dust, cinders, stone, metal or wood; the danger of injurious chemicals and splashing molten metal and sometimes of injurious light and heat rays; and of innumerable other accidents peculiar to the condition of the particular plant or office. Where such hazards exist progressive employers provide the necessary protective devices—goggles, shields and other safety equipment; all that is necessary is that the employee use these devices wherever they are provided, ask for them when they are not available, and exercise ordinary care for his own safety and consideration for that of the other fellow. The practical joker who shoots pins and paper clips and does other supposedly funny stunts in the shop or office has robbed many a man and woman of sight.

The eye hazards at home also are of great variety. Among the more common are burns from the splashing of lye and other cleaning preparations, flying tacks and nails, and jabs from knives, forks and scissors. Oculists everywhere have to treat cases in which a table fork or pocket knife, used to untangle badly knotted shoe laces, slipped and cut the person's eye. Similarly, attempts to remove caps from bottles and covers from food jars with the aid of knives, forks or ice-picks—a common practice in millions of homes—every year destroy or badly damage hundreds of eyes.

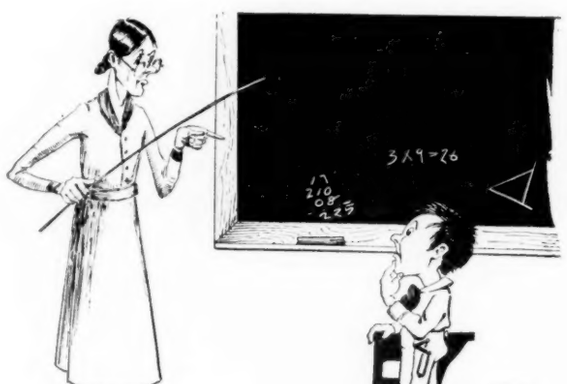
It is not proposed, of course, that the lady of the house wear goggles or that the man of the house use at home the same protective equipment that he would in the shop. There is needed merely, first, a recognition of the dangers to the eye in the home and, second, the use of common sense in guarding against them. This means that bottles, jars and jelly glasses will be opened with devices made for that particular purpose rather than with knives, forks and screwdrivers: that shoe laces will be untangled without the aid of pocket knives, forks or ice-picks; that nails will be hit square on the head instead of glancing blows; and that step ladders will be used in place of rocking chairs and tea wagons to reach high places on the wall.

*Co-author (with Lewis H. Carris) of "Eye Hazards in Industrial Occupations."

Of the eye hazards at play two are of such seriousness as to warrant mention in this limited space to the exclusion of all others. They are the accidents caused by air rifles and fireworks, not only during the Fourth of July, but at Christmas and other holidays in various parts of the country.

Despite all the publicity that has already been given to dangers involved in the shooting of fireworks by young children and in the indiscriminate use of fireworks by older children and adults, a surprisingly large number of casualties resulting in blindness or badly impaired vision are reported each year shortly after Independence Day.

And now conduct a little experiment. At the close of this article shut your eyes for just half a minute and with all the power of concentration at your command try to imagine during that half-minute how it would feel for you to spend the rest of your life with your eyes shut. Do that conscientiously; then go home and appoint yourself safety engineer to the family.



What Do You Know?

BY L. H. MORRISON

The answers are on page 76

Ques. 1—What is a comfort zone in heating and ventilating engineering?

Ques. 2—How are the tubes fastened in the head of vertical fire-tube boilers?

Ques. 3—Has a corrugated furnace any advantage over a plain cylindrical furnace in a Scotch marine boiler?

Ques. 4—What is the objection to CO in flue gas?

Ques. 5—What kind of coal can be burned in pulverized form?

Ques. 6—Has a tandem Diesel engine ever been built in the United States?

Ques. 7—What is meant by saturated ammonia vapor?

Ques. 8—Why do some crankcase scavenging two-stroke-cycle oil engines show a low mean effective pressure?

Ques. 9—What steam engine has a riding cutoff piston valve?

Ques. 10—How heavy is the counterweight made on an electric elevator in general practice?

REFRIGERATION
Equipment and Operation

Design Features of a Raw-Water Ice-Making System

By Terry Mitchell, M. E.

The author discusses the merits of various designs of agitating tubes, claims that medium pressures are the best and recommends the drawing of air from over the tank

THE fact that a large number of ice plants are still using the distilled-water system leads us to think of raw-water ice making as something comparatively new. On the contrary, years ago the plate system was producing good clear ice from hydrant water and successfully competing with the condensed-steam process. As early as 1890 there was a 100-ton plate plant in New Orleans, then the only plant in the world regularly manufacturing this quantity of ice and disposing of it. The Smith patents were responsible for the success of this installation, as of scores of others.

In the Smith system the ice was frozen in great sheets, on steel plates arranged vertically. The heat was transmitted through the steel to one side of the ice sheet only, while the ammonia cooling coils were on the opposite side of the steel wall. The water, before being frozen, was agitated by means of air bubbling up through a perforated pipe placed at the bottom of the water compartment; the same general idea of using air is employed today in all the recognized raw-water systems. At the New Orleans plant each cake of ice measured 16 ft. long by 8 ft. high and weighed more than six tons. That it was beautifully clear is shown by Fig. 1.

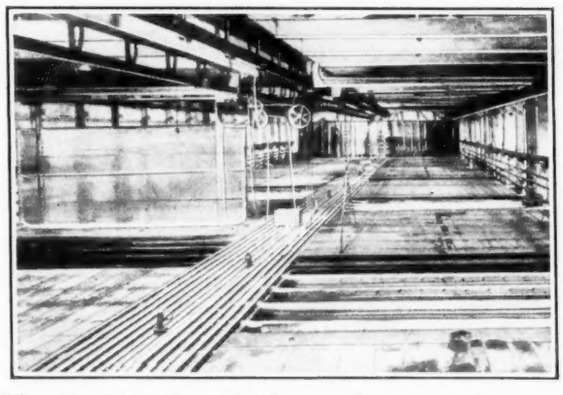


Fig. 1—Plate ice withdrawn from freezing tank

This ice was sawed into blocks before being placed in storage. Plants working on the plate system were built in most of the large cities throughout the South and East, and some of these are still in operation. But the method was open to objections which made it succumb easily when the distilled-water plants were perfected.

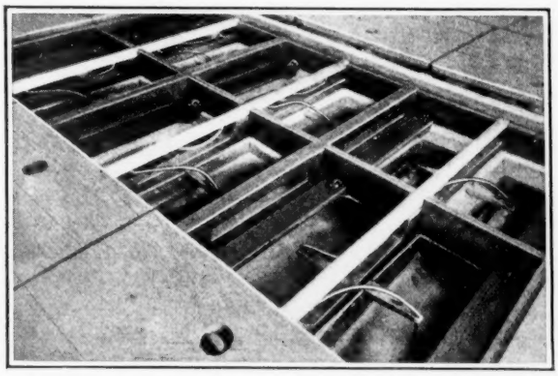


Fig. 2—Air connections to pendulum tubes

Ice made in the plate plants did not split nicely when struck by an ax or pick; it tended to shatter in all directions and, hence, was unhandy for the delivery men. Furthermore, it required anywhere up to a week or even longer to freeze one of the huge cakes, which meant that the ice tank must have a large number of compartments if ice was to be pulled regularly. The plate plants usually ran into large dimensions and were very expensive to build.

A few words will suffice to trace the steps that led to the perfection of the modern raw-water can ice system described herein. The early can ice plants, after the days of experimenting with water-circulating schemes, rocking cans and other mechanical methods were over, usually had low-pressure air supplied for agitation, using a $\frac{3}{8}$-in. galvanized pipe. The pipe hung in the middle of the can and was withdrawn before it was

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frozen into the ice. Later, the bracket supporting the pipe was changed to allow for the thawing needle, and the pipe stayed in place during the freezing process. Various arrangements of air valves, brackets and air coolers were tried, until preference began to be given to the high-pressure air system, which utilized a tube soldered to the corner of the can, where it did not have to be moved in harvesting the ice. The early low-pressure systems often had trouble with the air-cooling equipment, and the drop pipes in the center seemed to make a core as bad as did those fastened in the corner.

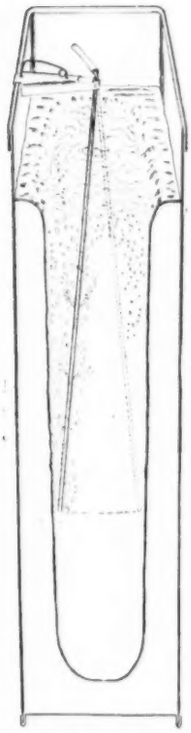

Fig. 3 — Swinging action of the air tube

So for a number of years attention was given to perfecting the high-pressure air system. From an initial air pressure of 60 lb. gage at the compressor and the consumption of 56 hp. per 100 tons of ice, improvements brought the figures down to 20 lb. gage and the equivalent of 25 hp. per 100 tons, for agitation The latter system called for so much less compressor work that it became known as the medium-pressure system. The hydrating equipment for the air was steadily improved until at present a good medium-pressure system can be relied upon to give trouble-free service.

Just as the medium-pressure air system was being perfected, the low-pressure system received a sudden stimulus, some four years ago, through the development of the so-called pendulum tube. This tube is suspended in the center of the can from a bracket that clamps tightly over its edge, a spring on the bracket engaging in the hole in the rim of the can. The tube is so pivoted in the bracket that it is free to swing back and forth across the can in the narrow way, but is restrained from motion the long way in order to keep the tube from swinging out of its proper plane, as shown in Figs. 2 and 3.

The combination of the central position and the pendulum motion of the tube results in a number of practical advantages. As the air bubbles out from its end, the tube swings slowly back and forth, causing the air to agitate the water thoroughly, first on one of the flat surfaces of the ice and then on the other. As all ice manufacturers know, this agitation of the unfrozen water washes off the impurities and bubbles that would otherwise freeze into the ice and make it opaque; "tombstone ice" has no market among housewives, these days. Thus the motion of the tube makes the ice unusually clear, as the water freezes in toward the core.

Most people judge of the quality of ice by the size of the cloudy portion in the middle, making the core the critical section of the block. Years of experimentation brought out the fact that the tube must freeze in the center of the cake if the core is to be of minimum proportions. The tendency of the tube, if swinging free from a simple hanger across the top of the can, is to freeze in a slanting position when the lower end catches in the narrow edge of the core space. This means poor agitation and an unsightly core. By restricting the motion of the tube to a plane at right angle to the core's greatest width, the ice, as it gradually closes in, is agitated uniformly, and by the time the end of the tube is frozen shut the bottom of what would have been the core has practically ceased to exist.

After the end of the tube has been stopped off, the agitation continues through a series of perforations, or minute holes drilled at certain carefully selected points along the length of the tube. The position of these perforations, on the sides opposite the plane of the motion of the tube, is designed to give proper agitation, without enlarging the core after the tube has been frozen fast. The cake of ice, when viewed from the narrow side, shows a core of sword-like thinness near the top, as well as at the bottom.

One of the chief difficulties with raw-water ice systems has been to keep the ice in the cans from becoming white when the power supply fails and the air pressure goes down. The difficulty has usually been that the air passages through the ice became filled with water and froze as soon as the compressor stopped or the reserve air tanks became empty. With the improved tube this source of trouble is overcome, and overcome with the same significant simplicity that characterizes the whole system. The pendulum tube, being always in the middle of the block, is surrounded by the unfrozen core water, and there is nothing to stop the flow of air when the power comes on again. The perforations just mentioned are particularly helpful in this respect, as they provide the necessary openings for the air in the cans in which the bottom end of the tube has been already frozen shut. With good average water the power and air pressure

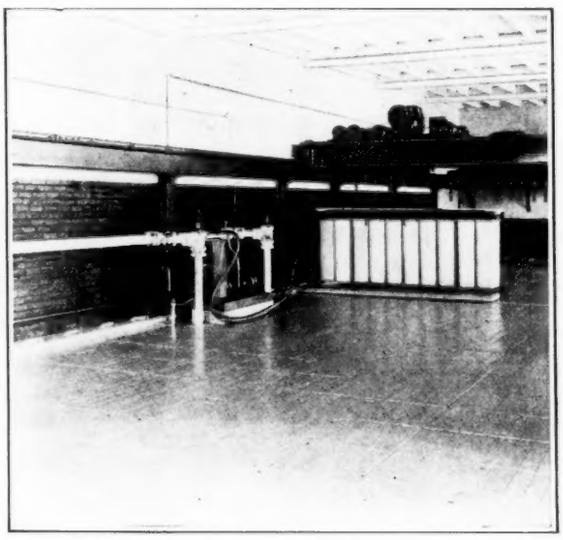

Fig. 4—Gang harvesting of can ice

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can be off for periods up to fifteen or even twenty minutes without spoiling the appearance of the ice.

Another cause of white ice used to be the clogging of the holes in the fittings which regulated the supply of air to each can. A drop of frozen moisture would shut off the air. To keep out this moisture, dehydrators and air conditioners were put into the air system. The pendulum tube requires air at a very low pressure, only just enough to overcome the friction in the pipe lines

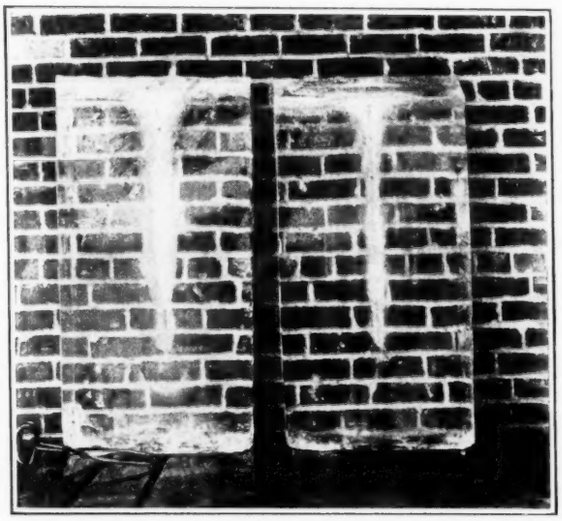

Fig. 5—Raw-water ice is decidedly transparent

and the head of water in the cans. The holes in the fittings are large enough to permit the air stream to pass through without a drop in pressure, and therefore without the cooling action experienced when air under pressure expands. Whatever moisture might get into the air laterals at times, will blow through the fitting and out of the tube. Hence the low air pressure used in this system accomplishes several things, all more or less dependent upon one another—it prevents stoppage of air passages, it helps to eliminate the dehydrators, and it saves power.

By using a simple rotary blower instead of an air compressor and operating at about 1.5 lb. pressure instead of 20 or 25 lb., the saving in power is obvious. Not only is two-thirds of the power ordinarily required for agitation saved, but the simplicity of the thing appeals to plant engineers. The blower calls for little attention and is economical in first cost. Either the rotary or centrifugal style is suitable for the pressure under which the system operates.

An ingenious method has been used to obtain air at the right humidity for the air system. A set of headers is run down the side of the tank, with short nipples leading through the framework into the space above the cans. The headers are connected to the suction of the blower, which is thus supplied with cool air regardless of weather conditions. In passing through the blower, the air is warmed and its humidity is therefore reduced. This is the exact opposite of the former method of drawing warm air into a compressor, heating it to a high degree in the cylinder and then cooling it to 25 deg. F. to eliminate moisture. The new principle does away with all dehydrators and gives a considerable saving in the refrigeration most dehydrating sets require. The recirculating plan of handling the air is direct and satisfactory, employing only the elemental equipment just outlined. In exceptional cases, as when operating a plant in winter in a damp climate, it has been found preferable to heat the air slightly after it leaves the blower, and for this purpose a radiafin pipe, wound with spiral fins of steel, is inserted in the main air header. Hot water or low-pressure steam can be circulated through this pipe when the occasion demands it, but most plants never require any heating of the air above that naturally performed by the blower.

The design overcomes many of the difficulties formerly experienced with air agitation, but it is open to some objections because of the extra labor required for handling the tubes. However, when we consider the savings in labor through the elimination of the air compressor and dehydrators, with their adjustments and upkeep, and the savings in lower horsepower required, about 7.2 hp. for agitation per 100 tons ice, it is not so hard to see why the raw-water system of this design has been widely accepted in the ice-making industry.

Driving Two Compressors With One Motor

MOST of the early ammonia compressors were fitted with belt wheels or were hooked up to steam engines. As the engine-type synchronous motors became better understood, they became the favorite drive for large and medium-sized units. Meanwhile various special drives were being used. Here a silent chain or even a set of gears was used, there a waterwheel was installed, and, in England especially, short-stroke compressors were driven at speeds up to 800 r.p.m. by direct-current motors. Direct connection to oil engines was employed with good results, although the number of such drives is still comparatively small.

While a great deal of attention was being given to these different drives, ten years slipped by before what is now one of the most popular arrangements, was worked out and tested to the point where it deserved serious consideration. This was the plan of connecting two machines to one motor. The machines are placed with the shafts end to end, in a straight-line pattern, as the auto designers would say, with the motor mounted between them. This may be properly termed the duplex-coupled arrangement, and is usually called simply "duplex," for short.

The shafts of the machines are coupled together in any one of several ways, since it would not be practical to use one continuous shaft for both pairs of cranks. The simplest method is to butt the ends of the shafts almost together and mount the motor so that half of its hub engages with each shaft. To make the connection more secure the motor hub is cast extra wide, and the machines

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are carefully lined up with each other. To disconnect one unit the entire motor is moved to one side.

A somewhat better arrangement, shown in the illustration, is to mount the motor between two bearings on its own short shaft and add flexible couplings for connecting up each machine. This allows us to uncouple either machine at will, leaving the motor undisturbed. The couplings take care of any slight misalignment that might occur, particularly as the bearings wear in.

A third plan would be to extend the shaft of one machine sufficiently to carry the motor, a pedestal bearing being provided beyond the motor hub, then connect the second machine by means of a single coupling. This design would save money, but would mean that flexibility and safety in case of trouble would be sacrificed.

When laying out a plant nowadays, the possible advantages of the duplex-coupled arrangement for the machines should be given consideration, especially if the compressor capacity involved is more than, say, 50 tons, although one quite satisfactory installation has two 6x6-in. compressors connected on this plan.

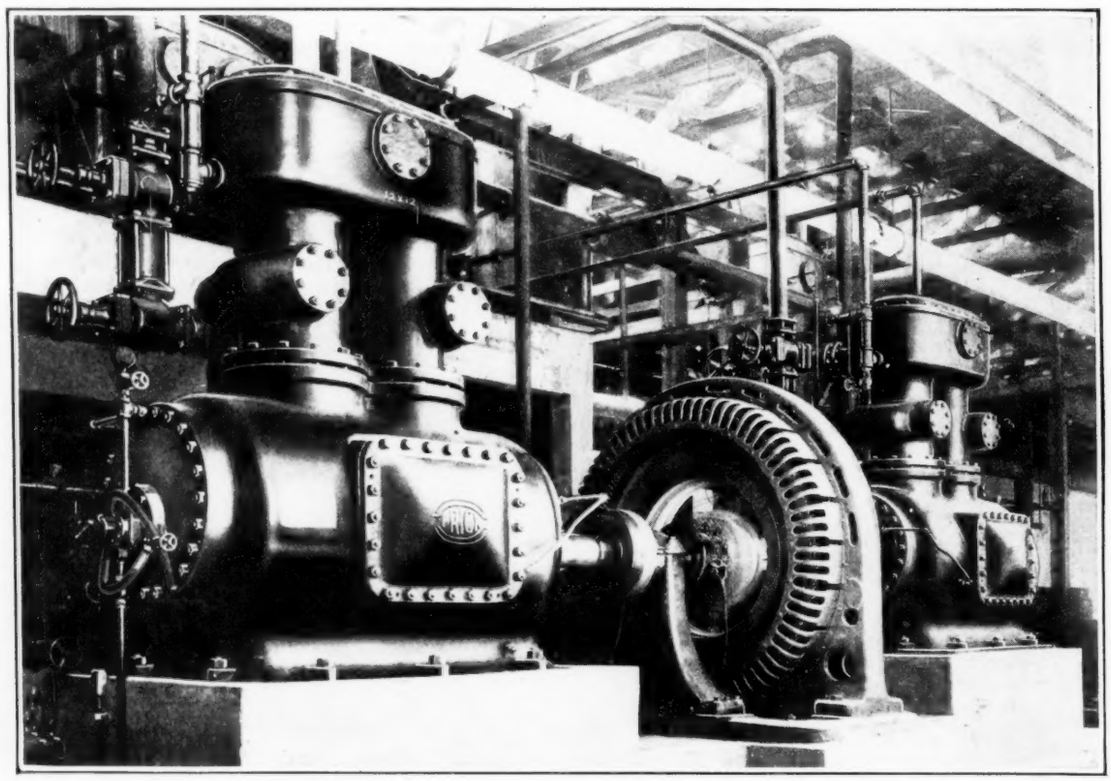
The most obvious advantage of the duplex arrangement is that only one motor has to be supplied, in the place of two. A single exciter set and a single control panel will suffice, with a worth-while saving over the cost of two complete drives. Since a synchronous motor is almost as efficient at half load as it is at full load, there is no great loss of power to be feared when only one compressor is working.

In selecting the compressors, it often happens that two smaller machines arranged in duplex will meet requirements as well as larger separate units. We then have the additional advantage of higher operating speeds for the motor and machines, with corresponding saving in size, weight and expense.

Another valuable feature is the unusual flexibility afforded by the coupled machines, which have four cylinders to call upon instead of two. Greater reliability is gained in case of an emergency. It is feasible to operate the two machines on separate loads, at different pressures, with a possible saving in power.

Using a single motor effects a saving in space, and the smaller machines save headroom. The concrete foundations are poured in one form. All told, the merits of this arrangement have frequently resulted in the selection of several duplex-coupled sets for large plants.

In specifying a duplex drive, attention should be given to the fact that extra flywheel effect must be provided in the motor if it is expected to drive one machine at a time. Although, when operating in this fashion, the motor is twice as big as the load, the unbalanced forces occur only half as frequently as with all four cylinders connected, and if current disturbances are to be avoided, extra weight is necessary.

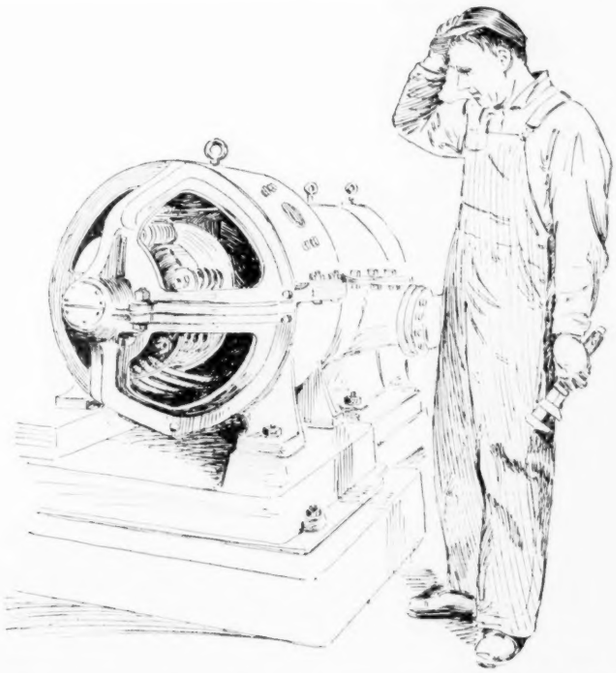


Two 12x12-in. twin-cylinder compressors direct-connected to a single motor at Mistletoe Creamery, San Antonio, Tex.

ELECTRICAL
Operation and Maintenance

Why Blame the Motor

When the Trouble is in the Load?



By N. L. Rea
Contract Service Department, General Electric Company

IT MAY be asked what an electrical man knows about pumps? The answer is "trouble." Human nature is prone to look for some mysterious cause or reason for trouble, and a centrifugal pump is so simple that no one thinks of looking for trouble there. If the pump won't run, telegraph or telephone the motor manufacturer that his motor is "on the bum," and to send a man at once. The trouble shooter needs must find the cause to get things running, so we have received some education that has been interesting and instructive.

One brisk fall day we received a long distance call that a large synchronous motor wouldn't start, and a steel mill was badly in need of the water that a centrifugal pump, connected to the motor, was intended to supply. A trouble man was dispatched forthwith. His report was somewhat as follows: "The pumping outfit was in, or rather under an open sheet-iron shed. It was cold, so I got a bar in the coupling and tried to move the rotor. I couldn't budge it, and it should have turned easily. I went out in the yard, gathered up some chips and built a fire under the pump. After a while it thawed out and then ran all right. It had been shut down over the week-end half full of water and the impeller froze fast."

I was sent out on a sewage disposal job, and found the customer already had a pump man on the job, and they were both sure it was electrical trouble, for the oil switch opened every time they tried to start the motor. A bar used as a lever in the rotor showed that the outfit was jammed, but the rotor would move a little on the spring of the long vertical shaft to the pump in the pit below.

The pump man just wouldn't believe it, and as the pump was under eight feet of raw sewage, you couldn't altogether blame him for being somewhat set in his opinion. So it was necessary to remove the coupling bolts and run the motor alone to convince him and the owner that the motor was not at fault. The pump was jammed with a mop, a few towels and other odds and ends. A finer rack stopped that trouble for several years, when trouble again developed. This time the pump turned freely by hand, but when the motor started and reached one-half or full speed, it would stop almost instantly, with the switches and fuses open. Disconnecting the pump showed the motor was all right.

There was a golf ball in the sump under the pump. The passages through the impeller were tapered, and the ball would go about half way through before it jammed between the plate of the impeller and the pump casing. I might say that the impeller was made as a cast-iron disk, and this had curved rectangular ribs to form the vanes. The intake to the pump was at the bottom, so the ball picked up when the pump was started and squeezed out when the motor stopped.

Prices were asked for on a pumping equipment to handle 400 gal. of water per minute against a lift of 75 ft. The request came from the electrical department, and we afterward found the customer's architect furnished the information for the pump specifications. We assumed that they had included suction, discharge and pipe friction in the 75-ft. lift and we proceeded on this basis. Later, it was found that the pump would not deliver any water.

A man was sent to meet the architect and locate the trouble. The pump seemed to be all right, so our man

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(one of the hard-boiled old timers) started checking conditions. The tank was several hundred feet away and the discharge pipe was 4-in. diameter with a valve and a number of 45- and 90-deg. elbows. The pump suction and discharge had been reduced from 7-in. and 6-in. in diameter respectively, to take 4-in. pipe. The pumphouse floor was 70 ft. below the tank. Our man started to measure the suction lift when the architect asked, "What are you measuring that for? The suction doesn't make any difference to a pump." "Is that so?" said the old timer, "Why didn't you put the pump up in the tank, and then you wouldn't have to run it?" That stopped further discussion for the time being.

The suction also had several elbows and a foot valve, as well as a gate valve. A check showed that the friction losses plus the suction, increased the operating lift to something like 160 ft. It was pointed out to the owner that a 6-in. pipe should be used in the discharge, and 7-in. in the suction, and that some of the elbows could easily be eliminated. A new impeller could then be furnished, and the pump would meet the conditions satisfactorily.

The customer advised that they had an economy campaign on, and all expenditures on maintenance were held up. Replacing the old pipe was maintenance. They could, however, order a new pump and would use the outfit they had at another location. They were told that a new pump would have to be two-stage and would require a 35-hp. motor instead of a twenty. It was also pointed out that it was uneconomical to pump water through the small piping, and that the power bills would be practically double. Nevertheless, they insisted on ordering the larger outfit, and it was installed in due time.

A month later we received a letter from another department in the customer's organization complaining about the size of the power bill and the inefficient outfit we had unloaded on them.

Copies of the previous correspondence were sent the writer, with an offer of any assistance in our power. No reply and no news for several weeks, then another complaint. They had installed 6-in. pipe, and the power bills were still excessive. Of course, when the two-stage pump was operated against a total lift around 90 feet, instead of about 170, efficiency fell away down. Another change had to be made to fit the pump to the job, before satisfactory operation was achieved.

Far too few operators appreciate that the centrifugal pump has to be designed to meet the operating conditions and that the efficient operating range is fairly small.

A Porto Rico sugar plantation reclaimed a large area of low land with a low-head centrifugal driven by a small steam-engine. This gave good service for the first season, and then they experienced trouble in keeping up steam. This gradually grew worse, until they couldn't keep down the water during heavy rains. All the trouble was laid to the boiler and engine, and a synchronous motor with silent chain drive was ordered to replace the engine.

Luckily, our local representative and one of our erecting engineers attended the starting. Several trials were made with increased settings of the compensator and relays. The last one nearly pulled the pump from the foundation, and they decided there must be something wrong inside the pump. The suction was opened, and the pump was found to be packed full of sticks, cocoanut shells, sugar cane and grass. When this was cleaned out, the unit worked satisfactorily and the customer decided a screen around the intake might be a good idea.

These are a few of many instances that prove the necessity of approaching apparent electrical troubles with an open mind and a liberal supply of horse sense. Don't start looking for the third or seventh harmonic the first thing. It is more than likely that a half brick or monkey wrench "is blocking the wheels of progress."

Chart for Selecting Direct-Current Conductors*

By C. Albert Kulmann

THE alignment nomograph shown in the figure is based on the resistance per mil-foot of copper conductor, and the value used is 10.37 ohms, as given by the Copper and Brass Research Association. Various other values are used, but this checks closely with the actual resistance as given in the various handbook tables. The two conductors of a circuit being usually in series, the constant was doubled to give 20.74 as the resistance per mil-foot of distance. The equation used is:

$$E = \frac{20.74\,L\,I}{A}$$

where E is the voltage drop in the line, L is the length of one conductor, or the distance to the load; I is the rated current carried by the line in amperes, and A is the area of the conductor in circular mils.

In order to determine the line drop where current, size of conductor and distance to load are given, lay a straight-edge from the scale value of "Length" to that of "Amperes" and note the intersection on the blank axis. Connect this point with "Wire Size" and read voltage drop. To determine the correct wire for a specified drop, connect the point obtained on the blank axis with the specified drop and then read wire size.

For example, assume that it is desired to know the voltage drop in a line 400 ft. long one way when the

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conductor size is No. 4 and a load of 50 amperes is being transmitted. First lay a straight-edge from 400 on the length-of-line scale to 50 on the ampere scale and mark the intersection with the blank axis. Then lay the straight-edge from the mark on the blank axis to 4 on the wire-size scale and read volts drop on the line-drop scale, which in this problem is about 10 volts.

If it were considered that a drop of 10 volts was too high and a conductor size was desired to give about 4 volts drop when transmitting 50 amperes, lay the straight-edge from the intersection mark on the blank axis, through 4 on the line-drop scale and read the size of wire on the wire scale. In this case the size is a No. 0.

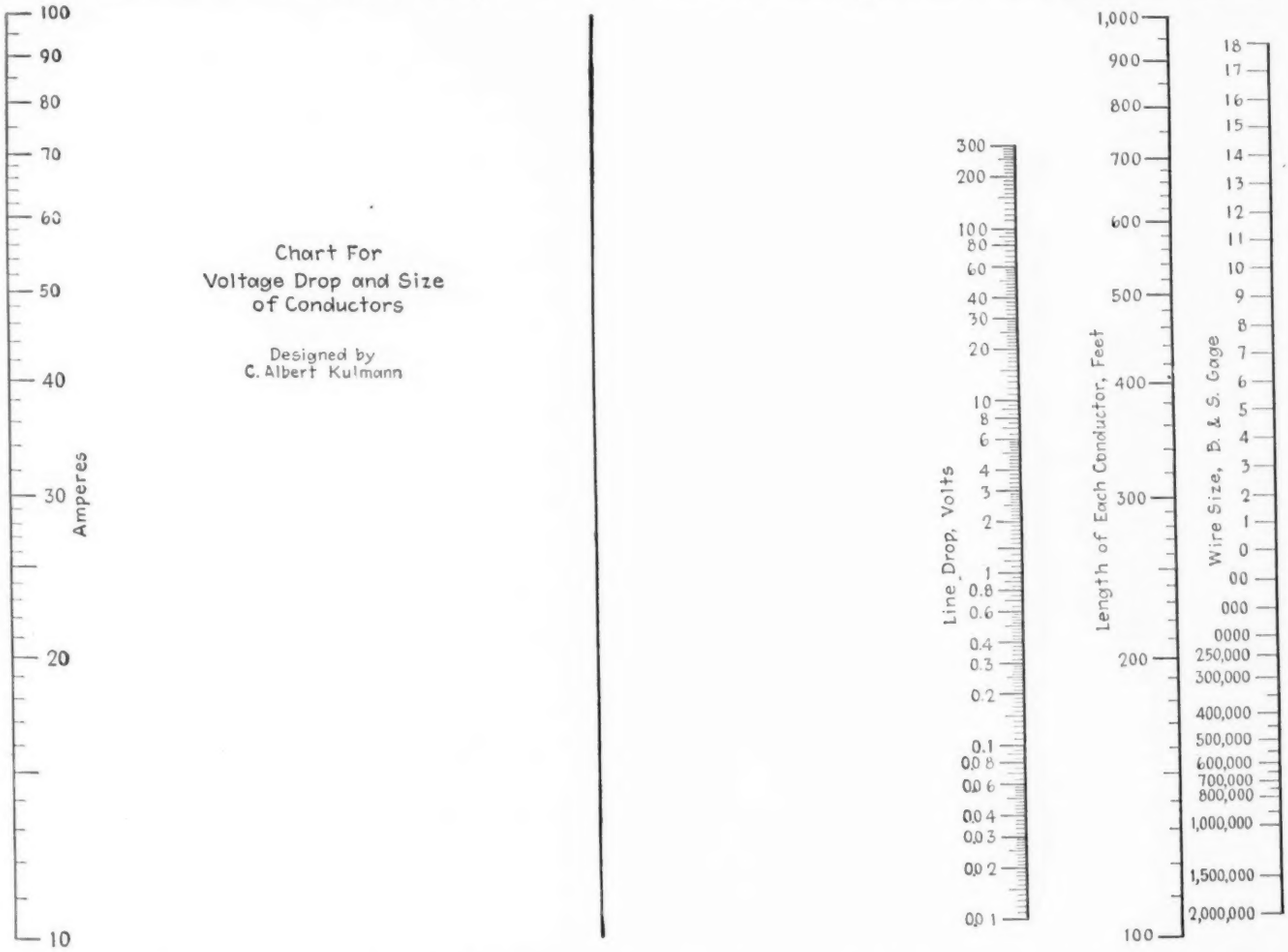
On the other hand, if it were decided to allow a 20-volt drop in the line, placing the straight-edge from the intersection on the blank scale through 20 on the line-drop scale will intersect the wire-size scale near No. 7, which is the size of wire that may be used.

Where the given data lie beyond the limits of the scales on the chart, divide or multiply any but the wire size by some power of ten. For instance, to find the size wire to give a drop of two volts where the distance is 400 ft. and the current is 80 amperes, connect scale points for 80 amperes and 400 ft. and note the intersection with the blank axis.

Since the scale value for current is ten times the actual value, the drop for any given conductor will be but one-tenth that shown on the chart, consequently the point on the blank axis is connected with 20 on the line-drop scale and the wire size is read off directly as slightly larger than No. 5.

If the current value were 250 amperes, the line length 1,500 ft. and the allowable voltage drop 12, the straight-edge would be placed from 25 on the ampere scale to 150 on the line-length scale. Since the current was reduced by 10, the voltage drop would be reduced by a like amount. The same also applies to the length of the conductor with regard to the voltage drop. Therefore, the voltage drop will be divided by 10 and then again by 10, or divided by 100. This reduces the voltage drop to $12 \div 100 = 0.12$. To obtain the size of conductor, lay the straight-edge from the intersection on the blank scale through 0.12 on the line-drop scale and read the size of conductor on the wire-size scale. This will be found to be about 650,000 circ. mils.

The nomograph is good for use on direct-current circuits. The size of wire after it has been determined should be checked with the National Board of Fire Underwriters table of wire sizes to see if the wire is large enough to meet the code requirements.



EDITORIALS

He Keeps the Plant Wheels Turning

A VISIT to the power engineer of a great automotive plant brought out the fact that, in addition to the generation of power, he was responsible for almost every other engineering activity of the plant except the actual production work on motor cars. Under his supervision were the following service departments: Electricians, pipe fitters, machine construction and repairs, blacksmiths, building construction and repairs, carpenters, material handling, tool and material supplies, building and process heat, plant cleaning and waste disposal, and general maintenance.

At first this seemed a large order for a power executive. But a little reflection brought the conclusion that it was the most logical type of organization and that most industries, which have only gone part way along this road to date, will eventually organize in this way.

This conclusion is based on two considerations. First, power generation is an exacting operation. The power plant manager must be a skillful engineer, accurate in his thinking and dependable in his work. He, therefore, is endowed with qualities that eminently fit him for these other responsibilities.

In the second place, in order to keep a power plant in operation, all these various services are required. Electrical maintenance is required by generators and motors. Pipefitting, blacksmithing and machine repairs are required to keep the power plant equipment in good operatating condition. Building repairs and carpenter work are incidental to power plant maintenance. Coal and ash handling is part of the regular routine, as is the generation and application of heat. And, finally, tools and supplies must be kept on hand and the plant must be kept clean and in good order, if it is to operate at all. Since all these services are necessary functions of the power engineer within the walls of the power plant, he might as well extend his activities to cover the same work outside those walls.

One other strong influence, in addition, acts to increase the trend toward such an organization. The production executives of industry are primarily interested in producing goods at the lowest possible cost. They, therefore, tend to devote all their own energies to production work and to centralize in the hands of the power engineer, in whom they can have confidence, all the other essential engineering activities of the plant. In this way they can be sure of having the least interference with their main interest—the low-cost production of high-quality goods.

Thus the old descriptive phrase applied to the power engineer, "He keeps the wheels a turning," is now doubly true. Not only does he supply the power that makes the wheels go around, but he also keeps these wheels in condition to turn.

Repair the Small Defects Before They Become Big Ones

A LARGE part of good maintenance consists of taking care of the little things. When plants fail to give good service, the cause can generally be traced to a neglect of the minor details of operation. A loose screw in one place, an oil leak in another, a small part worn in another are simple things that are potential sources of trouble. If repaired when they first develop, their effects are insignificant, but if neglected they may lead to expensive repairs and prolonged and costly shutdowns of equipment.

A valve that leaks a little, if left untouched, will soon cut itself to destruction. A loose nut may permit a machine part to vibrate and produce serious damage. A defective gasket may lead to graver difficulties. Little things of this sort grow bigger. Time does not heal such wounds.

Oil leaking from a bearing onto the winding of a motor or generator can usually be prevented at little cost by easily applied methods. If such leaks are allowed to continue, they are likely eventually to destroy the insulation of the winding, which will fail and may require complete replacement. To provide the latter is not only expensive, but it requires the machine to be taken out of service for a considerable period.

Commutators, if given a little intelligent care, will generally cause little trouble, but neglect of them may lead to all kinds of difficulties. If the surface is trued up periodically with a hand stone, the slots kept clean and the brushes properly adjusted, about ninety-five per cent of commutator trouble can be avoided. Small imperfections on the surface can be easily corrected with a hand stone, but if neglected may soon develop into a job that requires truing in a lathe or the use of a power tool mounted on the machine. Either of the last two methods necessitates taking the machine out of service, but the first can be done with the machine in operation.

Poor connections are always accompanied by heating. A little attention to this detail may prevent serious burnouts, the destruction of switches and unnecessary power

losses. A poor contact in a switch may raise the temperature to a point where the temper will be drawn from the clips, after which it will be almost impossible to maintain a good contact. One of the surest ways of ascertaining the quality of the connection between the end of a cable and its lug is by the temperature when under load. If this is abnormally high, the cause should be investigated and removed at the earliest convenience.

Motor and generator windings are subjected to wide variation in temperatures and to forces caused by the magnetic field set up about the conductors. These tend to cause movement of the coils and crack the insulation, allowing the entrance of oil, moisture and dirt. All these are enemies of good insulation and can be avoided by periodic cleaning and the application of insulating varnish. Periodic insulation tests will show how the insulation is maintaining its quality and give the danger sign of an impending breakdown.

It is a well-recognized fact that the cheapest kind of maintenance is repairing the little defects before they develop into something of consequence. A careful analysis of most serious troubles in plant operation will show that they started from some small defects that might have been detected and easily repaired. Then take care of the little defects, and in general the large faults will not develop.

"Consumptionist" Economics

NOT to be outdone by the psychologists, who have invented "behaviorism," a new school of psychological thought to fit a new era in the world's history, the economists tell us that the present is a period marked off from preceding times by the increased importance of consumption. All previous ages were characterized by the importance of production. Men were under the necessity of producing to the limit and consuming sparingly, else they were faced with scarcity and want.

But, today, the great need is for consumption. Production offers no major problems. It can be increased, apparently, without limit. The necessary function is that of consumption, which must be maintained at a level high enough to keep industry working at full speed, or prosperity lags and want begins to be felt.

There is difference of opinion as to the underlying cause of this new economy. The most likely cause seems to lie in the change of the life of our times from one based upon agriculture to one based upon manufacturing industry. Until recently, the fundamental source of all wealth was the produce of the soil. Today, this position is held by manufactured goods.

Whether this new economic theory is true or not, it fits the facts of present life. Therefore, it is worth while to note the effect of this "consumptionism" on the generation and use of power. Just as the production of manufactured goods seems to have no inherent upper limit nor to present any major problems, so is it with the production of power. Power can be produced in any quantity needed, there being no apparent technical or economic obstacles.

It therefore becomes of paramount importance for the power producing field to concentrate more of its attention upon developing an increased consumption of its products. If the power plant, in industry or in the utility field, is to reap its proper share of profits under a "consumptionist" régime, it must take the lead in promoting the consumption of its product—power in all its phases—by all consuming factors. In an age of consumption, when the selling function takes precedence over any other, it behooves the power plant engineer to take the lead in selling the products he makes. Otherwise someone else will get most of the profits.

Imagine the Savings!

IMAGINE what a difference it would make in the total fuel bill of some industrial plants if the oil, gas or solid fuel used for industrial purposes received the same care in purchase and handling as does boiler fuel. Nowadays, power plant fuel is usually purchased to specification and is unloaded, handled, stored, rehandled and burned in accordance with the most modern engineering practice. Unfortunately, the same cannot be said of industrial fuel. Too often, it is poor in quality, poorly applied, or both, with resultant heat waste frequently exceeding the heat utilization.

The power engineer, who has the major fuel problem in the plant and the specialized knowledge to deal with fuel problems correctly, is the logical man to supervise all fuel purchase and handling. But, naturally, he is sometimes reluctant to extend his duties and responsibilities beyond the power plant walls, even if it should make his position more important.

And the management does not care how much fuel is wasted. At least, if they do, they seldom care enough to establish an effective cost system which will show where the waste occurs. But if they did care and then put this important service up to the power engineer, imagine the savings that could be made!

FOLLOWING A STATEMENT that the Eighth Avenue subway system in New York City will probably be completed within three years, the New York *Sun* says:

Three years is considered by engineers as an inadequate time in which to construct, equip, test and prove power stations of a design and capacity sufficient to meet the needs of the new subways. It is probable, therefore, that the city will purchase its power, at least during the first few years of operation.

What a task it must be to test and prove these plants before they can go into service! Is this an excuse or a reason?

IDEAS *from* PRACTICAL MEN

Readers are urged to use this department for the exchange of practical operating information. A minimum of five dollars will be paid for contributions accepted

Practical Method of Removing a Boiler Tube

AS MOST engineers know, the job of removing a boiler tube, especially in a water-tube boiler, at the best is not a pleasant one. I have used and studied several methods and find by practical experience that the

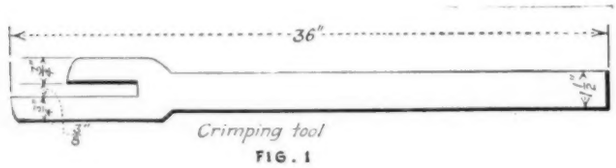


FIG. 1

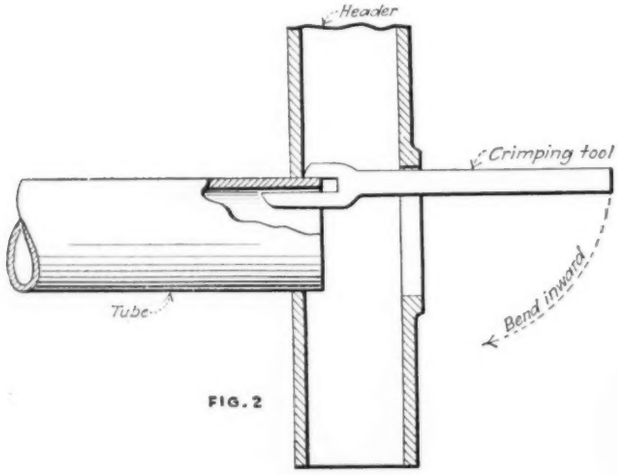


FIG. 2

Dimensions and method of using crimping tool

method I describe in this article is one of the easiest and the most economical in my experience.

No doubt quite a number of engineers are familiar with the crimping tool, which is made of 1½-in. machine steel, flattened at one end for the jaw, and not tempered too hard so that there is danger of its breaking at the jaw. If this device is made as shown in Fig. 2, it will be found to be one of the most valuable tools in the boiler room when used properly.

Water tubes, as specified, shall project through the headers not less than ¼ in. and not more than ½ in. Now extend the crimping tool through the handhole cap to the edge of the tube, as shown in Fig. 2, and bend the edge of the tube inward all around. It can then be removed easily without using an oyster knife or ripping chisel.

The use of the ripping chisel or oyster knife, particularly with an air hammer, is a rather ticklish proposition unless in the hands of an experienced mechanic, because the slightest dislodgment of the tool will cause a dent or cut in the header, and this means putting in a copper ferrule or grinding out the cut, which tends to enlarge the tube hole.

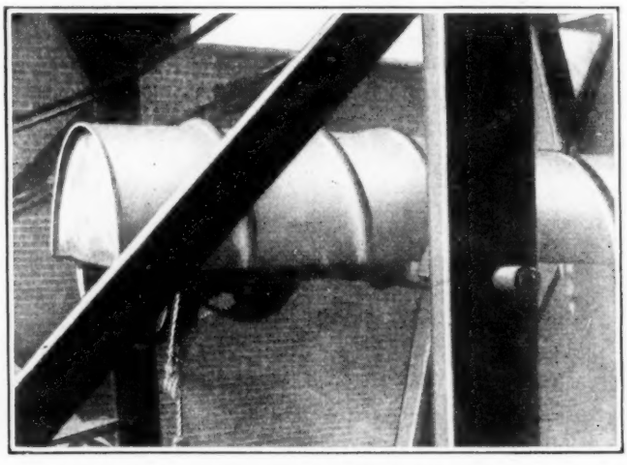
After a tube is bent inward all around at both ends, it can be easily taken out whole or in part by cutting in pieces with an acetylene torch. If the tube cannot be cut by a torch, it can be started by using a piece of hardwood a little larger than the diameter of the tube inserted through the handhole cap and giving a few taps with a sledge hammer. I am sure this method is quicker than ripping the tube and is more economical.

M. W. HORLEY, BOILER ENGINEER,
Holtwood Power Company.
Holtwood, Pennsylvania.

Protecting Belts Exposed to Weather

FREQUENTLY, it is necessary to use belts on the outside of buildings where they are not protected from the weather. The cover shown in the photograph is handy for keeping rains off these belts.

An ordinary iron gasoline or oil drum is cut into halves lengthwise with an acetylene welding torch. Each half is mounted to a support by riveting two strap hinges to its head and attaching them to the support, in a position that when the half-drum is turned down flat, as shown in



Belt cover made from oil drum

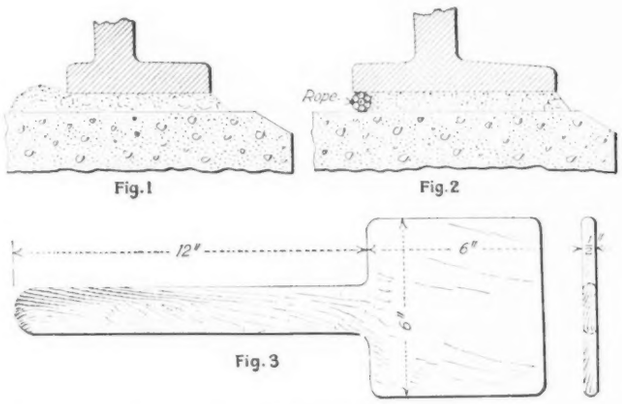
the photograph, it will completely cover the pulley that the belt runs on. Each belt is wound up and the cover turned down over it every day when the mill stops and during rain storms. It does not take long to prepare these covers and the cost is small compared with that of maintaining or replacing belts exposed to the weather.

Cairo, Ga. L. M. JORDAN.

Grouting vs. Bedding Machinery

THE usual method of bedding machinery by grouting is generally wasteful and often unsatisfactory.

To insure filling the space between the machine base and the foundation, the grout has to be made thin, which is harmful because, as is well known, the less water that



Figs. 1 to 3—Method of bedding machinery and paddle used to ram the cement

is used in making cement the stronger the cement will be when set.

A dam is built around the base of the machine to confine the grouting and to give it head, and this is wasteful. Furthermore, a great deal of puddling is necessary to work the grouting in and the air and water out, and this is bad again, because the less cement is worked after it is mixed the stronger it will be.

In spite of the care taken, those who have removed machines from their foundations have been surprised to find the surface of the cement filling with many pockets, caused by entrapped air or water. Often the cement is so poor that it can be crumbled between the thumb and fingers, the result of too much water and too much puddling.

There is a method of bedding heavy machinery which can often take the place of grouting with great advantage. I first saw it used in Cuba for bedding sugar machinery, which is heavy and vibrates considerably during operation.

The plan there was to go over the concrete bed with steel picks to remove all soft and loose material, and then it was washed clean. The bedplates were placed in position and leveled up on shims and wedges, leaving a space of from $\frac{3}{4}$ in. to 1 in. for the cement filling.

Cement composed of two parts of well washed sand, and one part of cement was now made, and only as much water used as would make a good stiff mix, so that when made into a ball, it would retain its form. If the top of the foundation had dried out, it was wetted again.

The cement was pushed in to a depth a little greater than the depth of the bedplate bearing, as shown in Fig. 1. This formed a barrier against which the rest of the cement was packed. One man went around forming the barrier, and another man followed to complete the filling. By the time the space was filled, the cement was ready for ramming with a wide and thick paddle or ramming tool. When the cement had been well rammed, it was ready for trimming and finishing. There was no shrinkage and no voids.

The erector informed me that he had bedded machinery in that way for several years and considered it far better than grouting for that class of machinery.

At that mill the steam turbine and pumps were bedded in similar manner, and I was there long enough to note how solid it was during operation. I left there a convert to that way of bedding machinery whenever possible.

A barrier can sometimes be made by driving in a piece of rope as in Fig. 2. Fig. 3 shows the kind of wood paddle used to push in the cement. J. JORDAN.

Long Beach, Calif.

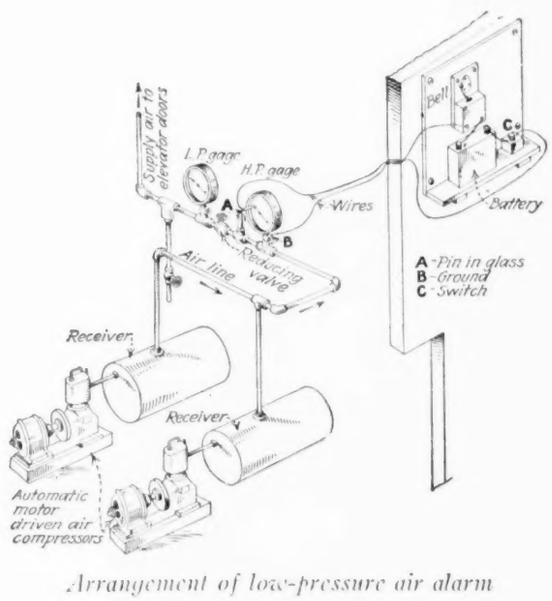
Low-Pressure Air Alarm

IN THE hotel in which I am employed the elevator doors are operated by compressed air, and on several occasions the air pressure has dropped too low to open the doors, a fuse having blown on the air compressor circuit. To overcome this trouble, we devised the simple electric bell alarm shown in the illustration, which warns the operators when the air pressure drops too low.

For drilling the holes in the gage glass, we used an old three-cornered file ground to a diamond point, using turpentine on the drill.

The terminal *A* can be set to any desired pressure on the gage by simply turning the glass after loosening the rim holding it in place.

The low-pressure air is maintained at 35 lb. and the



Arrangement of low-pressure air alarm

compressor "cuts in" at 45 lb. and out at 70 lb. If a fuse blows in the compressor circuit or the air pressure drops for any other reason, the hand of the high-pressure gage falls back to the pin, thus closing the circuit and causing the bell to ring.

The low-pressure point can be set so that there will be sufficient time to get the compressor into service again before the pressure has dropped too low to operate the doors. C. MCEWAN.

Edmonton, Canada.

COMMENTS *from* READERS

Preventing and Extinguishing Fires

ALTHOUGH most forms of buildings designed and built at the present time are practically fireproof, yet not infrequently a fire within such a building, starting from an unknown origin, causes considerable damage.

Many fires that just started without any accountable reason, might have been caused by oily rags, piles of rubbish or other combustible material slowly oxidizing and resulting in spontaneous combustion. Poor ventilation and heat are two good factors for promoting spontaneous combustion. Ordinarily, steam heating pipes and electrical machinery would not of themselves start a fire, but they contribute the temperature which is so helpful for the oxidation of combustible material.

Oily rags are a source of many fires. Oils and grease oxidize rapidly, and the rapid oxidation generates heat. Poor ventilation will lessen the heat dissipation. Castaway clothing and oil-soaked cloths used to wipe machinery, should be collected in a metal can and emptied periodically, the contents being preferably burned.

There are other causes of fires starting from unknown origin. Cobwebs and dirt collecting about a motor or other electrical apparatus which produces any arcing are often ignited by the sparks or static on belts, etc. Thus it will be seen that a dingy, unkept section of a building is a likely place for a fire to start.

Water is not a very efficient fire extinguisher, a large quantity being required to put out even a small blaze. There are several bad features about using water to extinguish a fire. A small quantity of water thrown upon a fire quickly changes to steam, separating the oxygen and hydrogen, which really supplies more fuel for the flames. To put out a fire with water two results must be produced. One is to drench the combustible material so it will not burn. Second, it must be smothered, by cutting off the supply of air. Water is objectionable and should never be used in putting out a fire where high-voltage wires are present; for the water will conduct the high-pressure current and make it hazardous for the firemen. Sand and chemicals are safer extinguishers that can be used about electrical installations, but some of the chemical extinguishers have a corrosive effect upon the machinery.

Chemical extinguishers, while more expensive, have greater efficiency. Ordinary chloride of lime ($CaCl_2$) is about seven times as effective as the same amount of water in putting out a fire. Since the best method of fire extinguishing consists of smothering the flames, any chemical or chemicals that react to generate a non-burning heavy gas such as carbon dioxide, can be used for the purpose. The heavy gas forms a blanket, shutting off the air from the flames. Carbon tetrachloride is widely used as an extinguisher, and the combination of sulphuric acid and sodium carbonate, in separate compartments, comprises the hand-operated fire fighters that we see hanging in so many places. The gas blanket referred to here operates in the same manner as a canvas or other blanket. The CO_2 gas blanket will not ignite.

Great care must be exercised in trying to put out a fire with a burlap or other loosely woven material, since the flames will tend to push through and ignite it.

Baldwinsville, N. Y. A. J. CHRISTOPHER.

* * * *

What Caused Pitting on Turbine Journals?

THE problem of journal pitting, referred to by J. W. Baker in the Sept. 27, 1927, issue, is one frequently met with in alternating-current machinery. It is caused by eddy currents set up in the armature, which break through the oil film between the shaft and the bearings, causing an arc, which burns and pits the shaft. Although the machine referred to was a new one, doubtless it had been run on the testing floor of the factory, which would give ample time for the shaft to pit.

There are several ways of correcting this trouble. One is to insulate the bearing pedestal from the bedplate, and another is to place a set of brushes on each bearing end of the generator shaft. The brushes must make good electrical contact with the shaft, and the holder must make good electrical contact with the bearing cap. A set of standard slip-ring brush-holders and brushes make a practical arrangement for this purpose.

West Frankfort, Ill. R. A. GREEN.

AS THE turbine was a new one, the pitting was probably done when it was running on the test bed. Sometimes turbines have to be run for a considerable time before they can be balanced properly. If the lubricant used was at all acid, it may have caused the pitting or it may have been due to stray electric currents circulating in the shaft and passing to the bearings and then to ground. Trouble of this kind is not uncommon in turbines, and it has frequently led to a decomposition of the bearing oil.

In some cases where this trouble has been encountered, the joints and bolts on the bearing pedestal have been given a coat of insulating varnish which usually was sufficient to insulate the pedestal from the bedplate. This would seem to me to be a probable explanation of the pitting, but there might have been an electrical fault on the generator which accelerated the trouble. To suggest that it was due to a defect in the forging does not seem feasible, for if a shaft were pitted it would probably have internal defects and therefore would not get by the inspector. W. E. WARNER.

Stafford, England.

Saving With an Accumulator

IN THE Dec. 13, 1927, issue, on page 915, you review two papers presented before the Industrial Power Session, including my own paper on the Ruths Steam Accumulator. There is a statement in the last paragraph of the discussion which not only is in error, but seriously affects the standing of the accumulator. This paragraph was as follows:

"In closing, Mr. Langworthy stated that customers usually want about 25 per cent return on the investment. Where properly applied, an accumulator will usually show a saving of 10 to 11 per cent. Moreover, accumulators make the operator's work easier due to more constant pressure, and here is another indirect saving. The accumulator is best adapted to handling peaks of from one-half to one hour in duration."

I did make the statement that in general manufacturers throughout the country required a return of 25 per cent before they would consider any new investment in machinery or equipment. I further stated that the accumulator was always applied by this rule and in most cases would pay for itself in two or three years, which means a return of 33⅓ to 50 per cent.

You can plainly see that the statement of a saving of 10 or 11 per cent practically puts the accumulator out of the running when a return of 25 per cent is the standard of measurement. Since the savings which the accumulator will accomplish is one of our strong points, I want to ask you to correct this error so that people reading this issue will not carry away the impression of a 10 per cent to 11 per cent saving.

New York. R. A. LANGWORTHY,
Vice-President & General Manager,
Ruths Accumulator Company, Inc.

* * * *

What Scale Costs

IF THE average efficiency of fuel consumption were brought up to maximum efficiency, how much fuel would be saved annually in the United States? How much in the individual plant? Considering public utility companies alone, the average efficiency is only one-half of the best efficiency, according to the United States Department of the Interior.

On Sept. 19, 1927, the Department of the Interior released its report contrasting average efficiencies of public utilities producing electricity with the efficiency of the best of such plants for the year 1926. A summary of conclusions are, for average plants, 1.94 lb. of coal per kilowatt-hour, 243 kw.-hr. per barrel of oil, 22 cu.ft. of gas per kilowatt-hour; for the best plants, 0.9 lb. of coal per kilowatt-hour, 450 kw.-hr. per barrel of oil, 13 cu.ft. of gas per kilowatt-hour.

The conclusion drawn in the report is that if average efficiency were raised to best efficiency, fuel consumption in all public utilities producing electrical energy would be reduced one-half, or more than 20,000,000 tons of coal, representing a value of about $75,000,000.

A staggering total, is it not? But it is small compared with the total savings possible if power plants of all types are considered. Not only is the number of power plants other than public utilities much greater, but the consumption efficiency is conceded to be lower. The opportunities, therefore, of reducing the total fuel consumption in the country are stupendous.

A considerable share of the cost of excessive consumption of fuel can be laid to a common condition and one easily remedied. Reference is made to the practically universal presence of scale adhering to boiler tubes. The fact that the waste is imposing and the corresponding opportunities great is hardly disputed.

As a result of experiments of the United States government, it has computed the increased cost due to scale when producing 3,450 lb. of steam per hour as $1,459, or 14.88 per cent for one-sixteenth inch of scale and $2,030, or 59.84 per cent for one-quarter inch of scale. This is based on coal at only $1.50 a ton. A leading manufacturer of boilers states in his catalog: "So many factors enter into the effect of scale on capacity and economy that it is impossible to give any accurate figures on such decrease that will serve in all cases, but that it is large has been thoroughly proved."

These conclusions are furnished by disinterested observers, but even more convincing are the experiences of actual power plants in which effectual steps have been taken to eliminate scale. Figures showing gratifying savings are endless. For example, a steamboat company saved 250 tons of coal in two years by this means, in the operation of a single ship containing two boilers. A hotel in New York saved 25 per cent of its fuel bill by cleaning its boiler tubes, and $150 a month represents the saving of fuel by a public utility company in North Dakota.

The close relation between boiler scale and fuel consumption is well known by many officials who are responsible for the marketing of coal. A curious instance of this was the case of an agent of a certain coal mine. This agent sold his brand of coal on the basis of competitive tests with other brands of coal already in use but, before submitting to any such test, he first took the precaution to have the boiler tubes cleaned of scale.

To operators of power plants who envy the consumption efficiency of the most efficient plants, the suggestion is made that they can make a grand beginning by securing the immediate and thorough removal of scale from their boiler tubes. It is not predicted that the consequent fuel reduction will amount to 50 per cent, but the chances are favorable indeed that a long step will be taken in that direction. W. H. DAY.

Buffalo, N. Y.

* * * *

Corrects Report of Discussion at A.S.M.E. Meeting

I SHOULD like to call attention to some errors and omissions in the report of my discussion at the A.S.M.E. Annual Meeting, as published in the Dec. 13, 1927, issue.

The relative investment figures given apply only to the boiler units and not to the completed sections, as may be inferred from the report. The description of the boiler unit fails to mention the important fact that the three boilers supplying the last 50,000-kw. turbine are equipped with two unit mills per boiler. No mention was made of the fact that the boiler tests reported were given as E. H. Tenney's contribution to the discussion. The temperature of the preheated air reported in this test was 265 deg. F. and not the stack temperature. I might also add that the 170,000 lb. output from the boiler is equivalent evaporation.

New York City. H. G. THIELSCHER.

How to Cut Gage Glasses

WITH reference to the answer given to Question No. 9 in the What Do You Know column of the Aug. 23, 1927, issue on how to cut gage glasses, and to the several comments that have since appeared on this subject, I should like to add that it may be all right for some engineers to cut a notch all around with a file or to cut a notch on one side of the glass, but try making a slight scratch with a rat-tail file on the inside of the glass, and you will be surprised with the results; in fact, it has all other methods beat. ALEX A. MATHIESON.

West La Fayette, Ind.

* * * *

The Chief Engineer Sees the President

SCENE One, President's Office; time, any day; place, the average manufacturing plant.

Enter Factory Superintendent, with some papers in his hand. The President is seated at his desk.

President—"Good morning, Mr. Greene, what is on your mind this morning?"

Superintendent—"I came in to talk about those two old machines that we have in the factory. They are out of date and are holding back our production at least 10 per cent, owing to the time required for them to complete their part of the operation in the manufacturing of our product. In addition to this they are expensive to keep in repair, costing us around $800 a year, and as they are obsolete, the repair parts must be manufactured, entailing the expenses of patterns and special machine work, I have here a proposition to install two modern machines that will save the labor of two men and increase our production 10 per cent. These machines will cost $20,000 and save in repairs $800 with the labor of two men at $3,600, or a total of $4,400 a year."

President—"That sounds attractive, and it would be well to scrap the old machines and put in these new ones. Have the salesman call tomorrow."

Scene Two, same as Scene One; time, next day.

Enter Chief Engineer with some papers and memorandum. The President is at his desk and apparently busy.

President—"Hello, Smith, what's the trouble now?"

Chief Engineer—"I came in to talk about some improvements that we can put in the plant that will save us money by reducing the cost of operation and the cost of fuel. As it is now we are running blind. I have no way of telling what the cost of generating power is, except the monthly coal bills, and that is little help. I cannot tell which boilers are loafing on the job or which ones are doing their full duty. I need a flow meter on each boiler and pyrometers to tell how much heat we are losing up the chimney. Then for each boiler I should have a draft gage, with a CO_2 indicator, and a recording CO_2 instrument to check the 24-hour performance of the whole plant. With these I can spot the losses and stop them."

President—"What will it cost to put all this in and what will it save?"

Chief—"It will cost $5,000 and will save 10 per cent of the fuel, amounting to $500 a month, or $6,000 a year, over 100 per cent on the investment."

President—"Well, see me some other time about this, but I warn you now that we cannot spend that much on the plant. You will have to cut it down some."

Curtain.

Wilkes-Barre, Pa. T. M. STREET.

What Makes Boilers Drum?

THE letter of H. M. Toombs in the Nov. 8, 1927, issue raises an interesting question.

Out of perhaps a thousand boiler installations that I have actually worked upon, only one suffered from drumming. This was the old Judd Street plant of the Crane Company in Chicago, having several horizontal water-tube boilers and chain-grate stokers. The drumming occurred at a certain rate of combustion and apparently originated in the breeching. This was a large steel breeching, and the intensity of the vibrations was felt most acutely when one stood in a position to receive the sound waves from an exposed portion. These sound waves apparently were most intense in a direction perpendicular to the large, flat side of the breeching. They were so intense as to be actually painful and felt as if there was an air hammer working at one's chest.

At a slightly higher or lower rating the drumming ceased, and we could stop it almost instantly by opening the large side inspection door in the furnace.

This is not an explanation of the phenomenon, but merely an addition to the evidence from which perhaps someone else can extract the reason.

Harvey, Ill. JOSEPH HARRINGTON,
Joseph Harrington Company.

Answers to What Do You Know?

The questions are on page 62

Ans. 1—The comfort zone is that range of effective temperatures at which 50 per cent of people feel comfortable, and lies between 62 deg. and 69 deg. effective temperature.

Ans. 2—If the tubes are over 1½ in. in diameter the ends must be rolled and beaded.

Ans. 3—Yes. The corrugations permit the hot furnace sheets to expand without stressing the rest of the boiler.

Ans. 4—The presence of CO in the flue gases indicates that insufficient air is present to afford complete combustion.

Ans. 5—Up to date practically every kind of coal, including anthracite, bituminous and lignite, has been pulverized.

Ans. 6—Yes. An engine of this type was built years ago by a New England firm and installed in Florida.

Ans. 7—Ammonia vapor is said to be saturated if its temperature is that corresponding to the pressure carried. This "saturated" temperature is the temperature at which, if the vapor be cooled an infinitesimal amount, dew or liquid ammonia will appear.

Ans. 8—The low mean effective pressure is a result of the imperfect scavenging of the cylinder, so that on the next stroke the cylinder is filled with a mixture of burnt gases and air, in place of air only, and not so much fuel can be burned.

Ans. 9—The Buckeye steam engine was equipped with riding cutoff piston valves.

Ans. 10—It is equal to the weight of the car plus 40 per cent of the rated load. If the car weighs 4,000 lb. and the rated load is 3,500 lb., the counterweight should weigh $4{,}000 + (3{,}500 \times 0.40) = 5{,}400$ pounds.

New and Improved EQUIPMENT

Sullivan Vertical Air Compressors for Small Capacity and Stand-by Service

FOR shop, power plant and miscellaneous industrial requirements in which a relatively small amount of compressed air is needed, and where compactness, continuous operation and practically automatic control are important factors, the Sullivan Machinery Company has designed recently, two new vertical direct motor-driven air compressors of the two-cylinder and four-cylinder types. These machines are intended for small plants or shops where air requirements are not large, or for use in large installations in which isolated departments need air, where the distance from the main compressor plant is considerable, or for stand-by or night service when it is desired to save operating costs by shutting down the main compressor unit. Both machines are single acting and similar in design to the portable air compressor units made by this company.

In the two-cylinder machine the cylinders are cast in one block and bolted to the crankcase, and the one-piece cylinder head is bolted to the top of the block. Baffles below the open end of the cylinder prevent oil from being thrown into the cylinder. The wafer valves for both inlet and discharge are placed in bored recesses of the cylinder head and are accessible by means of removable covers. To remove dust and solid matter from the air, a filter is attached to the intake opening. The steel shaft has two cranks, 180 deg. apart, with opposed counterweights to balance the inertia effects of the reciprocating parts.

For supplying oil to the crankcase, a combination breather and strainer is mounted at one end of the case. It is provided with a spring hinge cover, equipped with a valve, and opens to prevent accumulation of pressure in the case, but prevents any inward flow of air from the outside. The rim of t' flywheel dips into the pool of oil in the well and by its rotation throws this oil upon the crankshaft bearing nearest to the wheel and into a channel in the crankcase above the wheel. From this channel the oil is conducted through a pipe to the crankshaft bearing nearest the motor. The excess oil flows through the splash pans under the cranks maintaining an adequate supply for distribution to the crankpins and pistons.

The four-cylinder vertical compressor is a new departure in design. Instead of using two large cylinders, this model employs four of a proportionately smaller size. The cylinders are placed in pairs at an angle of 90 deg. with each other, forming the V-type arrangement shown in Fig. 2. As the two connecting rods for opposite cylinders attach side by side on one crankpin, only two cranks are required for the four cylinders. The shaft is but slightly longer than that used in a conventional two-cylinder machine and requires the same number of bearings for its support. The light weight of the reciprocating parts and the V-type arrangement has reduced to a minimum the forces causing vibration. Other features of the design are similar to those of the two-cylinder compressor. The speeds of the two machines are the same, and the capacities 120 and 240 cu.ft. of free air per minute, respectively.

Direct- and alternating-current motors, together with control equipment for hand starting and stopping or for full automatic control, are available. Automatic control of the compressor cooling water also may be arranged to stop the flow of the water when the motor is at rest and to start the circulation when the motor is again placed in motion.

Some of the important features of these units outlined by the manufacturer are: Smooth operation, with practical freedom from vibration; compactness; automatic lubrication; wafer automatic inlet and discharge valves; water-cooled cylinder barrels and head; an automatic sweep control unloading device; flexible external gear coupling between compressor and motor; and adaptability to automatic control of various types.

Of these various factors elimination of vibration is outstanding. The crankshaft is counterbalanced, and to insure even running a flywheel is placed at the outside end of the compressor crankshaft, and the compressor flywheel and crankshaft assembly are balanced both statically and dynamically.

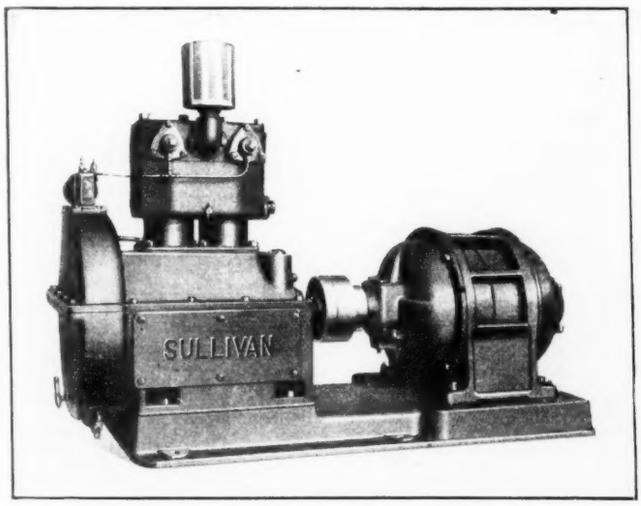


Fig. 1—Sullivan vertical two-cylinder motor-driven air compressor having capacity of 120 cu.ft. per minute

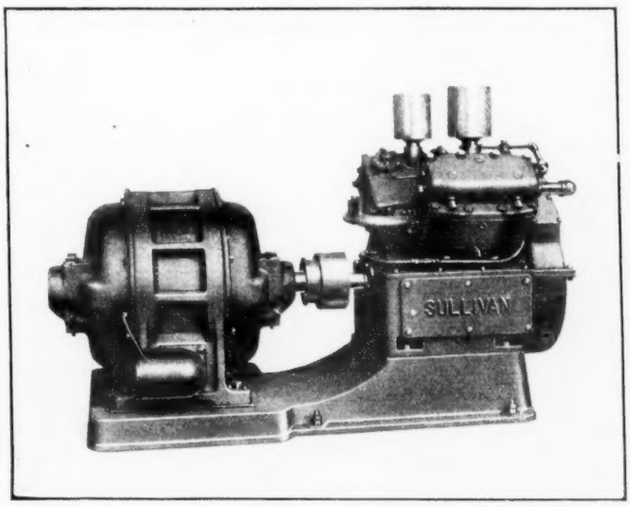
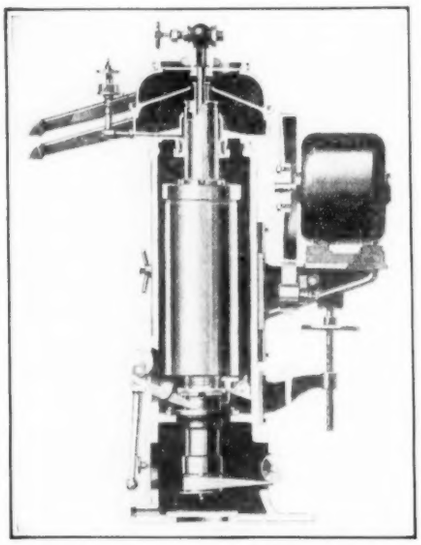


Fig. 2—Sullivan V-type four-cylinder direct-motor-driven air compressor of 240 cu.ft. capacity

"Positive" Separator and Clarifier for Lubricating Transformer and Fuel Oils

A CENTRIFUGAL separator that is readily convertible into a filtering clarifier is a recent development of the "Positive Machinery Division" of the National Acme Company, Cleveland,



"Positive" separator and clarifier for lubricating, transformer and fuel oils

Ohio. The machine is especially adaptable to the separating of water and other foreign matter from lubricating, fuel and transformer oils.

The unit combines two operations in one, as it is designed not only to separate liquids of different specific gravities, but also to clarify the liquids at the same time. This feature is advantageous in cases where oil sometimes requires separation when the water content is high and at other times requires clarification where residue content is high.

The unit operates through the medium of revolving tubes or sleeves through which the liquid flows and against the inner surfaces of which it is held by centrifugal action. The centrifugal force drives to the surface of the cylinders the heavy foreign matter, and at the same time a high pressure is built up which drives the liquid lengthwise along the tubes. It travels in this way over 100 in. before it is discharged and in this travel is thoroughly rid of the particles held in suspension at the beginning of its travel.

Dams or rings of suitable height hold back the sludge or the impurities, and this material, from time to time, is cleaned from the inner surfaces of the tubes. The tubes are readily removable for cleaning and have a large capacity for holding the impurities, so that frequent cleaning is not necessary.

When used as a clarifier, a filtering sleeve of filter paper or other similar material is placed between the inner and outer revolving sleeves of the machine. The hydraulic pressure developed in rotation then drives the liquid through the filtering sleeve at a high rate, thereby adding to the centrifugal action a secondary filtering action which eliminates even the finest foreign matter.

The bowl is carried on two sets of ball bearings, one being mounted rigidly on the housing and the other supported by a spring that serves as a cushion or shock absorber. The machine is made in the stationary type with open or closed feed and in the portable type with independently motor-driven supply pump.

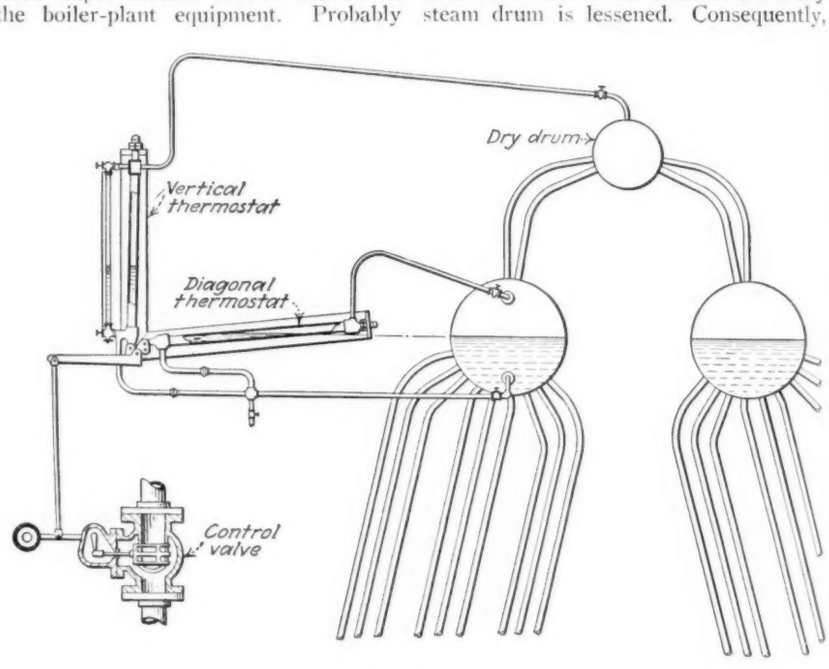
New "Copes" Regulator for Large Boilers Operating at High Ratings

THE high ratings at which the modern types of large boilers are now being operated has imposed new duties on the boiler auxiliaries and necessitated improvements in this branch of the boiler-plant equipment. Probably the most important of these auxiliaries is the feed-water regulator, owing to the small water capacity of the drum as compared to the high rate of evaporation and also owing to the tendency of these high ratings to cause wide fluctuations in the water level when the load suddenly changes. To better meet these new duties, the Northern Equipment Company, Erie, Pa., has brought out the new "Copes" regulator illustrated.

The new unit is controlled by a combination of steam flow and water-level movement and consists of a double thermostat with two expansion tubes, each of which actuates the same control valve.

Referring to the illustration, it will be seen that the water level in the expansion tube of the vertical thermostat is higher than the water level in the expansion tube of the diagonal thermostat, for the reason that, on account of the friction loss through the connecting tubes, the steam pressure in the dry drum to which the steam connection of the vertical thermostat is made, is less than the pressure in the main steam drum to which the steam connection of the diagonal thermostat is made.

The vertical thermostat is designed to operate normally the control valve, increasing or decreasing the feed, dependent on the flow of steam from the boiler. As the flow of steam from the boiler increases, the drop in pressure between the main boiler drum and the dry steam drum increases. This causes the water in the vertical thermostat to rise. As the level in the vertical thermostat becomes higher, the thermostat contracts and opens the control valve supplying more water to the boiler. As the load decreases, the difference in pressure between the main boiler drum and the dry steam drum is lessened. Consequently, the level in the vertical thermostat lowers and less water is supplied to the boiler.



Regulator controlled by a combination of steam flow and water-level movement, both thermostats operate same control valve

If for any reason the vertical thermostat does not move the control valve a sufficient distance, there will be a change in the water level in the main drum, and the diagonal thermostat will, in turn, readjust the valve and compensate for any variation produced by the vertical thermostat. Any adjustment necessary in the normal water level is readily made by means of the nuts on the top of the vertical thermostat.

Progress of Fuel Utilization in 1927

By R. T. HASLAM and J. T. WARD

THE last year has been characterized by progressive development of equipment and methods previously introduced, rather than by startling new innovations in fuel utilization. In practically every phase of combustion engineering this development has been rapid and well balanced, inasmuch as improvement has been made in practically all branches of industrial equipment.

During the first three months of the year, it being feared that a strike of the Miners union was in prospect, every effort was made to increase the amount of coal in storage and to continue the operation of many of the unionized mines with non-union labor. When the strike did materialize, its effects were minimized to the point that that there has been no serious depletion of stock.

The monthly production of bituminous coal for the country as a whole has been slightly greater than consumption, and accumulative output of bituminous coal up to the middle of October has been only 20,000,000 tons less than for the corresponding period last year.

The increased electrical output per ton of coal indicates clearly the progress that is being made in fuel economy in power generation.

STOKER-FIRED FURNACES

In the large furnaces the trend toward the use of some form of water-cooled walls continues steadily, the principal advantages being reduced furnace maintenance cost and the securing of improved combustion conditions, and in increased capacity and efficiency.

Installations of bare and refractory-lined water walls have operated a sufficient length of time to permit definite conclusions to be drawn. These reports are apparently unanimous to the effect that water-cooled walls materially reduce furnace maintenance. The tests of such installations indicate lower wall radiation losses. Rear walls constructed of refractories have been replaced by water-cooled walls with a resulting lessening of clinkering. Water-cooled walls generally result in lower stack losses. However, trouble is experienced in maintaining efficiency with some coals at low rating.

The use of carborundum refractories for the clinker zones of front, side and bridge walls and clinker pits of stoker-fired furnaces has proved to be excellent practice. They are also used in the side walls of chain-grate furnaces. The solid brick appears to be much longer-lived than are the perforated blocks, some of which have been reported to crack across the face, particularly when clinker is being removed.

The use of over-fire air injection with underfeed stokers, in one installation at least, has resulted in decided increases in over-all efficiency as well as in practical elimination of bad smoke nuisance. The secondary air is admitted at the coking part of the fire, and a corresponding amount is eliminated from the back end of the stoker. A worth-while increase in efficiency was not found with the better grades of coal. Stoker designers have paid particular attention this year to the reduction of maintenance. Improvements in the design and details have been made in practically all types. However, there have been three major changes in stoker construction this year: Increased length, improved air distribution methods, structural changes occasioned by the increase in length as well to permit the use of more highly preheated air. Better air cooling of parts exposed to heating has been provided and extensive redesign of grate furnaces to permit the use of air preheated to 500 deg. and upward has taken place. However, the temperature of preheated air in the average installation does not exceed 350 deg.

AT THE annual meeting of the American Society of Mechanical Engineers the progress in fuel utilization during 1927 was presented in a report contributed by the Fuel Division, of which John Van Brunt is executive chairman.

The developments taking place in chain grates are quite analogous to those made on stokers, the increased areas used being approximately 10 per cent of those of last year. Improvements in drive mechanisms have also been made, notably by the increased use of water-cooled drive shafts. The introduction of secondary air through the arch has been successfully applied in chain-grate installations. It has cut down arch maintenance, improved combustion by reducing combustibles and, as might be expected, has produced no noticeable reduction in the radiation of the arch necessary for ignition.

The increased use of pulverized fuel, both for new equipment and in the conversion of old installations, continues unabated. The Prime Movers Committee reports a remarkable increase in the use of unit systems during the past year. There are approximately 200 plants now using pulverized fuel where the size of the undivided heating units is 5,000 sq.ft. of heating surface or over. In the utility field no distinct trend toward either central preparation or unit pulverizer systems is apparent.

Means have been found in both systems to handle coal successfully with a higher moisture content than formerly. The steam-heated drier seems to have been largely discarded for other types, no one of which appears to present outstanding advantages.

During the year the installation of burners using the turbulence principle has greatly increased over any previous period, and is due largely to the necessity of securing increased combustion rates per unit of furnace volume. This type of burner has also been found to permit reduction of excess air and to facilitate ash separation. In most instances it has been applied where water-cooled walls have been installed and where preheated air is used.

There has been no radically new development in pulverizing coal. Manufacturers are making some progress, however, in the construction of mills that will maintain uniform fineness of particles with constant output over the length of the grinding surfaces.

Operating results are now available on the well-type furnaces installed in the Charles R. Huntley station of the Buffalo General Electric Company. Each furnace of the most recent group of boilers, incloses a volume of 10,200 cu.ft. and is capable of developing from 60,000 to 270,000 lb. of steam per hour. Over-all efficiency with an excess of 85 per cent has been reported. This construction permits the use of coal with an ash fusion point of 1,900 deg. F.

What may prove to be an outstanding development of the year in the field of pulverized coal is the equipping of the United States Shipping Board vessel "Mercer" with powdered coal burners. The equipment consists of a preliminary crusher and unit pulverizers with turbulent type burners.

LOW-TEMPERATURE CARBONIZATION

The outstanding development in the field of temperature carbonization is the announcement by the International Combustion Engineering Corporation that a plant of the Kohlenscheidungs Gesellshaft type would be erected for

the purpose of furnishing gas to the Public Service Company of New Jersey for domestic use.

In England arrangements have been made to erect in a gas plant a full set of carbonization retorts that have been developed by the Fuel Research Board. Both this installation and the K. S. G. plant referred to are intended to operate on a strictly commercial basis.

Natural gas referred to in past years as being in danger of rapid extinction, has come into much more extensive use for both domestic and industrial purposes. The discovery of new gas and oil fields has been responsible for this increase, and the extensive construction of new high-capacity pipe lines from the fields to distribution centers has steadily reduced the wastage of this fuel which has been prevalent. This wastage is still tremendous, but concerted efforts are being made to regulate its production and distribution.

The Petroleum Situation

The year 1927 has seen the maximum daily production of petroleum ever attained in this country, when the highest daily output reached over 2,500,000 bbl. Nothwithstanding the large supplies of fuel oil made available, the greatly increased consumption of fuel oil for power generation which might have been expected, has not taken place. Undoubtedly, this is due to the feeling that the supplying of low-priced fuel oil would be of such short duration that conversion to oil-burning equipment would not be economical.

Germany reports that the Bergius process for the liquefaction of coal has been placed on a commercial basis, and an extensive plant at Manheim is reported to be capable of producing 1,000,000 bbl. of oil annually. The raw material from which this oil is produced is German brown coal or lignite. The process consists in treating the lignite, which has been made into a paste with oil, with hydrogen at 1,500 to 3,000 lb. pressure and at a temperature of 400 to 500 deg. F.

In the light of all the facts it is difficult to be other than optimistic on the prospects for a continued supply of motor fuel of all kinds.

In the field of gas manufacture much interest has been caused by the coke dry quenching process installed at Rochester. In this system inert gas is circulated through the hot coke in a container and then through a boiler. The sensible heat of the coke is then transferred to steam at 140 lb. pressure. The results of this process indicate a heat recovery of 69 per cent of the heat in the coke. Coke at 1,800 deg. F. and cooled to 400 deg. F. produced 430 lb. of steam per ton of coke. Taking all charges into account, the actual cost of steam made was 34.4 per 1,000 lb.

The majority of the large European stations recently contracted for are using the central-storage system of pulverized coal burning, although numerous stoker installations have been made. This development has been carried on by European representatives of American manufacturers and the type of equipment employed does not differ materially from that used in the United States.

The use of high-pressure steam in Europe is indicated by the development of the Benson boiler. A unit of 66,000 lb. capacity is in operation, and the construction of another of 300,000 lb. capacity is reported. A boiler of this type generating steam at the critical temperature and at 3,200 lb. pressure has also been projected for locomotive work.

Attempts are being made to remove the boiler drum from the fire and evaporate the water indirectly. Notable among these is the Hartman boiler at Cassel, where the evaporating is done by high-pressure steam generated in a coil boiler. This steam is passed through a coil in the main boiler drum to produce the major evaporating effect. Among other interesting developments, of which there are as yet few data, may be mentioned the Stratton furnace, which burns crushed coal (not pulverized) by suspension, the Schultz vertical-tube boiler and submerged-flame combustion.

Engineering Education Appraised by Professional Societies

AN APPRAISAL of engineering education by members of five professional societies is presented in Bulletin No. 13 of the Investigation of Engineering Education, just issued by the Society for the Promotion of Engineering Education. The bulletin summarizes the results of inquiries made by the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Chemical Engineers.

This report, which covers more than 50 printed pages, gives in graphical form the reaction of selected groups in each of these societies to a series of questions relating to the adequacy of present-day engineering education in its various phases. In all, nearly 2,000 members were canvassed. Of these, about 60 per cent replied, and about 54 per cent were recorded.

The consensus of opinion obtained from the questionnaire may be boiled down to the following statement of principles:

A. College training has become the normal first step to professional standing, but experience in subordinate capacities is an indispensable part of the training of engineers.

B. Engineering is a broad function in social economy with various types and grades of responsibility. No single program, as in medical or dental education, can meet these varied needs.

C. Engineering is concerned with technological, economic and administrative problems; it has an immensely ramified scheme of individual specialization along both technical and functional lines, and is further divided by grades. It is impracticable to reproduce this complex pattern in a workable scheme of formal education, nor can students make valid choices among the many fields of specialization. The schools should therefore concern themselves with underlying principles. Principles are best taught in connection with their application.

D. It is deemed impossible to reproduce engineering problems as a whole in the artificially simplified setting of a school. Professional preparation must be begun in the school, but must be completed in practice.

E. The principal curricula of the engineering college should be differentiated from one another to a moderate degree only. In general, actual specialization should be postponed to the years after graduation, and be undertaken either in the graduate school or in connection with the introductory experience.

F. The program of the engineering colleges should be built up on broad lines from humanistic, scientific and technological materials of a basic character. A substantial core of English and economics, of mathematical and physical sciences, and of subjects which develop the scientific bases of engineering technology, should form the common foundation of all undergraduate curricula.

G. Relatively few institutions should undertake to provide special training in specific fields of engineering practice, and this training should be largely in postgraduate courses.

H. The economic aspects of engineering, as well as its technological aspects, deserve considerable emphasis in all engineering subjects. Engineering students should be given some introduction to the problems of administration and management, but no attempt should be made to give specific training for executive positions.

I. The quality of engineering education is determined primarily by the qualifications and effectiveness of teachers and the preparation and aptitude of students, rather than by curricula and equipment.

J. The engineering profession, through its national societies, should share in responsibility for shaping the programs and standards of engineering education. There is a substantial plurality of opinion in favor of giving formal recognition, in admission to membership and the support of student branches, to institutions which meet or exceed reasonable minimum standards in their requirements for admission and graduation, and in the qualifications of their teaching staffs.

NEWS *of the* FIELD

Pacific Power & Light Company to Expand By Acquiring Seven Concerns

Transformation Calls for Purchase of Utilities in Oregon, Washington and Northern Idaho Now Operated by Company—Thirteen Plants in Deal

Plans to make the Pacific Power & Light Company a $40,000,000 utility corporation and one of the largest of the Pacific Northwest were announced recently by Guy W. Talbot, president.

Expansion and transformation of Pacific Power & Light into a larger concern will be accomplished through absorption of properties now operated but not owned by the company.

Seven companies of Oregon, Washington and Northern Idaho will be absorbed. As now constituted, the company's assets are about $25,000,000.

13 Plants to Be Operated

The company will emerge, after the plans are consummated, with nine hydro-electric and four steam power plants. The plants will have a generating capacity of approximately 50,000 kw.-hr.

Plans disclosed that the Northwestern Electric will acquire properties in Clark and Cowlitz Counties, Wash., and Columbia County, Ore., now affiliated with the Pacific company, but operated by Northwestern.

The most important among the companies to be absorbed in the unification plan is the Inland Power & Light Company near Lewiston, Idaho, and Clarkston, Wash.

Other Companies Involved

Other companies to become integral parts of the Pacific system are Deschutes Power & Light Company, Grangeville Electric Light & Power, Sherman Electric Company, Enterprise Electric Company, Deschutes Ice Company and Yakima Central Heating Company.

Hydro-electric plants of the unified company will be those on the Clearwater River, Wallowa River, White River in Tygh Valley, Hood River, Naches River, Walla Walla River, Deschutes River, Crooked River at Grangeville. The steam plants are at Yakima and Walla Walla, and at Condon and Heppner, Ore.

Jones Bill Seeks to Double Power Commission Staff

Doubling, without cost to the government, the personnel of the Federal Power Commission, which is now five years in arrears on the work of passing upon licenses for water-power development, is proposed in a bill fathered by Senator Jones of Washington and Representative Burton of Ohio.

This effort to speed up power development at a time when demands are pressing proposes to put the license fees collected into a special fund, from which the commission can pay its personnel, thereby carrying out the intention of the act, which authorized such fees "for the purpose of reimbursing the United States for the costs of the administration" of the act.

For seven years, the commission has been operating with personnel borrowed from the Departments of Agriculture, Interior and War, although it collects on license fees an amount at least 50 per cent in excess of the cost of work. It needs, the commission has reported to Congress, about twice its present personnel to meet the increasing number of applications for water-power development, and to keep a proper check on the actual costs of construction that are charged into capital accounts.

International Handbook on Commercial Arbitration

Publication of a new International Handbook on Commercial Arbitration by the International Chamber of Commerce is announced by the American Arbitration Association. The work has been made possible through the cooperation of the International General Electric Company and the American Arbitration Association in honor of the late Anson W. Burchard, first president of the American Arbitration Association and chairman of the board of the International General Electric Company.

The commercial arbitration procedure for each country will be described first in separate pamphlet form, in order to be readily available to business men engaged in foreign trade with such countries. The first installment of the Handbook describing "Commercial Arbitration under Swiss Law" has just been received by the American Arbitration Association. When the brochures for all countries are issued they will be combined and published in bound volume form as a complete manual on the commercial arbitration laws of the world.

Renews Plea for New York State Power Authority

Governor Smith in his eighth annual message to the New York State Legislature Jan. 4 renewed his request for the establishment of a New York State Power Authority.

But he shifted his position, somewhat, in that he suggests that such authority, when created, prepared a comprehensive plan dealing with the production and distribution of hydro-electric energy, which before any development would be written into law by the legislature, in the same manner that a comprehensive plan for the development of the port of New York was enacted in detail in the law giving that body power to function.

Jadwin Flood Control Plan Likely with Valley Support

Despite the criticism that has been leveled at the flood control plan of Major General Edgar Jadwin, the Chief of Engineers, which has been adopted by the Administration, there can be no doubt that it has powerful support in Congress.

It is contended by those who support the Administration plan that there are many flaws in the project proposed by the Mississippi River Commission. It is argued that the Jadwin plan provides for a greater degree of protection for the valley at less cost and can be written into law at this session if the valley will join hands with the administration. But it is felt, in Administration quarters, that legislation at this session is unlikely if the valley should unite behind an alternate proposition.

Wisconsin University Plans Welding Conference

A three-day conference on welding, to include instruction, demonstration and lecture sessions, will be held at the College of Engineering of the University of Wisconsin, Madison, Feb. 8, 9 and 10.

Special features of the conference will also consist of exhibits of welding and cutting equipment, instruction for operating welders, sessions for engineers and designers, welding in structural work, in foundries, railroad shops and repair shops. An automobile repair "clinic" will be set up.

Registration, for which no fee will be charged, should be made to Prof. J. M. Dorrans, College of Engineering, University of Wisconsin, Madison.

Muscle Shoals Bill Provides for Sale of Power, Fertilizer Production from Funds

Recommended by President, Bill Holds Out Advantages in Distribution of Power to South, Hastening Tennessee River Projects, and Relieving Congress of Contract Negotiations

A BILL is being prepared to put into legislative form the recommendations of the President and of the Secretary of Agriculture for the disposition of Muscle Shoals. While the exact provisions of the bill have not been announced, they will call for the sale of the power at a reasonable price and the use of the funds thus received in conducting experiments in the production, distribution and use of concentrated fertilizers.

In the opinion of those who favor this plan, its advantages would include relief to Congress of the necessity of negotiating the terms of a complicated contract, and the necessity for making additional appropriations of public funds; it would preserve the plants as an agency for national defense and assure its utilization in promoting the business of fertilizer production; it would permit the distribution of power to various sections of the South, and would release the ban that has been imposed for a number of years on the water-power developments in the upper stretches of the Tennessee River and its tributaries in the State of Tennessee.

Norris and Madden Bills

Two propositions are now pending in Congress. One, by Senator Norris, before the Senate Committee on Agriculture, is essentially a government operation and ownership plan both with respect to fertilizer production and generation, distribution and sale of power. It authorizes appropriations for additional power equipment that would cost perhaps $15,000,000. It directs the Secretary of War to operate the power plants for a period of ten years and sell electricity to states and municipalities, individuals, partnerships and corporations, and for the purpose of equitable distribution of the power in the different states authorizes him to lease or construct transmission lines in any direction. It directs the Secretary of Agriculture to construct and operate production plants for making and distributing fertilizer, one to be located in the vicinity of Muscle Shoals.

Pending before the Military Committee of the House is a bill by Congressman Madden for the execution of a contract with the American Cyanamid Company for a fifty-year lease of the Muscle Shoals properties, on condition that the United States expend an additional sixty-five or seventy million dollars for building two additional power plants, one at Dam site No. 3 and the other at the Cove Creek site, near Knoxville, Tenn.

Strong Opposition Seen

The contract proposes that the lessee will engage in fertilizer production on various stipulated conditions such that it assumes no definite obligation to produce fertilizer in quantity except as it may be done at a profit and with no assurance that its cost to the farmer will be competitive. The contract invests the lessee with exclusive and unregulated control for private use of the entire power output.

Each of these proposals will provoke strong opposition in both houses of Congress. It is not believed that a majority of the members of Congress will support government operation of power plants and sale of electricity, in competition with private industry, nor is it believed that the Congress is willing to expend an additional $65,000,000 or more on the Muscle Shoals project in order to secure a lessee who undertakes to engage in a program of fertilizer production of doubtful outcome.

Public Hearings Planned for Walsh's Utility Inquiry

Before considering the action it will take on the Walsh resolution, which proposes a minute inquiry by a special committee of the Senate into practically every phase of the public utility business, the Committee on Interstate Commerce plans to hold public hearings. The hearings will begin Jan. 16.

Apparently, it will be developed by these hearings that the public service commissions will not be in accord with the Walsh proposal. The feeling among the utility commissions, it was stated at the headquarters of their association in Washington, is that there is no need for additional regulative machinery. They look upon the utilities as essentially local enterprises.

N.E.L.A. Slates N. Y. Course in Illumination

A course in illumination for electrical contractors, believed the first of its kind ever given in New York, will be launched Jan. 17 under the auspices of the Lighting Committee of the Metropolitan New York Section of the National Electric Light Association.

The course of five lectures, with demonstrations, will be given at 8 p.m. on Tuesday evenings for five weeks in the Electric Building in Long Island City, N. Y., similar courses will be given in the other boroughs of the city.

Favors Report by Commission on St. Lawrence Project

The report of the International Joint Commission that investigated the St. Lawrence waterway project would be accepted by Congress under a resolution presented by Representative Mapes, of Michigan.

To put the recommendations in this report into effect, it is proposed to create an international board of engineers to work out detailed plans for the construction and operation of the waterway. Attention would also be paid to the matter of ascertaining the maximum efficiency of water power for such a waterway. It is further recommended that this waterway be not less than 30 ft. deep.

An appropriation of $100,000 is recommended to defray the expenses of this international body of engineers, the money to be paid out of the Treasury on warrants drawn by the President. The expenses of the Canadian section would be paid, of course, by the Canadian government.

Anthracite Output Falls Off 3,390,000 Tons

Production of anthracite fell off more than 3,000,000 tons, or 5.5 per cent, in 1927, the output last year, based on official figures to the middle of December and estimated tonnages for the remainder of the year, having been about 72,000,000 tons, against 75,390,000 in 1926.

In making these figures public Jan. 2 the Anthracite Bureau of Information said that, of the factors entering into this reduction in production, weather conditions were the most important.

"For the ten years preceding 1927, including the two abnormal war years, 1917 and 1918, and the abnormal strike years of 1922 and 1925," said the bureau, "average anthracite shipments were 65,671,043 tons. Shipments for the year just ended were therefore, about 3.5 per cent below the ten-year average and about 5.5 per cent below the 1926 record."

Total commercial production—that is, production less the coal consumed at the mines for power—was given as 66,000,000 gross tons in 1927, compared with 69,648,000 the previous year. Shipments to markets outside the region last year aggregated 63,500,000 gross tons, against 67,248,946 in 1926. The largest shipments on record were in 1918, when 76,307,687 tons were sent out of the region.

Vancouver Plant Ready for Operation Next Month

Construction of the Alouette power plant by the British Columbia Electric Railway Company, Vancouver, has been pushed with all possible speed, and it is expected to be delivering power to Vancouver early in February, according to report.

The second consignment of equipment recently arrived in Vancouver and was shipped from there to Alouette. This shipment included a 12,500-hp. hydraulic turbine and auxiliaries. The Alouette project was first conceived by the Burrard Power Company in 1907, and when the British Columbia Electric Railway Company took over that concern in 1910, the project was under consideration. Unexpected delays occurred, however, and operations were postponed on the outbreak of war in 1914.

In 1921 the British Columbia Electric Company took over the western Power Company of Canada and, with the addition of the Stave Falls plant to its properties, the original Alouette plan was revised to suit the new conditions. In 1924 the new Alouette project was launched, and since that time work has been pushed ahead steadily. The cost of the work is estimated at $2,300,000.

Japanese Power Companies in Merger

The largest public utility merger to date effected in Japan is announced by the Tokyo Electric Light, and the Tokyo Electric Power Companies. The amalgamation will be effective April 1, 1928. The new corporation will be known as the Tokyo Electric Light Company. The capitalization will be roughly $203,570,000.

The amalgamation will have 19 per cent of the power generating capacity of Japan and 15 per cent of the paid capitalization of the nation's electric power industry.

The Tokyo Electric Light Company was the first private company to be established in Japan. It began operations in 1887, at that time generating power by coal. Hydro-electric power was not developed commercially until about 1907. The company already has absorbed several companies and now commands the total subscribed capital of about 300,000,000 yen, the largest corporation in Japan.

Welding in Power Plant Topic of Joint Meeting

At a joint meeting of New York sections of the American Society of Mechanical Engineers and the American Society of Welding Engineers, Jan. 3, two papers were presented showing the application of welding to pipe lines in the power plant.

The first paper was by A. W. Moulder, chief engineer of the Brinnell Company, and dealt with welding of power plant piping with the oxyacetylene torch. The author limited his treatment to this type of welding because the problem involved is not one of production and because the oxyacetylene welding torch and the oxyacetylene cutting torch are both necessary on the same job.

Welding Advantages Classified

The advantages of the welded pipe joint was classified as including:

(1) The elimination of flange joints decreases the cost of piping; (2) decrease in weight of pipe line; (3) elimination of the flange joint, which makes possible a more continuous insulation, greatly decreasing the cost of insulating pipe lines, and (4) service in erection is greatly facilitated and special fittings can be made in the field.

Results were shown of tests on full size 6-in. pipe joined with socket weld joints, socket and pin weld joints and a screwed coupling joint welded at both ends. Of 72 test pieces 53 pieces failed outside of the weld and only 19 pieces failed at the weld. The tests disclosed that the socket and pin type joints developed cracks around the pins considerably before the pipe failed, showing the pins to be a detriment to the joint rather than a benefit.

Arc-Welded Pipe Lines

An attempt was made to determine the magnitude and character of the internal stresses existing in a weld joint. Strain test showed these stresses to be compression stresses between 10,000 and 30,000 lb. per sq.in. It was found that annealing the joints eliminated these stresses, but since these stresses are compressive stresses, the author felt that annealing is unnecessary. A more complete abstract of this paper will be given at a later date.

The second paper presented was by W. L. Warner, of the General Electric Company, and consisted mainly of a description of several arc-welded pipe line installations used for carrying steam and water at pressures of not over 250 pounds.

Discussion brought out the desirability of licensing welders who are to work on high-pressure pipe lines and that two states, Michigan and Ohio, had provided codes for licensing such operators. One company reported that during 1926 it had laid 3,000 miles of gas welded pipe and that practically no trouble had been experienced from leaks.

Obituary

Norman S. Burnham, for the last fifteen years sales representative in southern New York, Connecticut and Brooklyn, for McLeod & Henry Company, Troy, N. Y., died in the Fifth Avenue Hospital, New York City, Dec. 30, after a week's illness. Before associating with McLeod & Henry Company, he was for many years a subscription salesman for *Power*.

Benjamin F. Jones, Jr., chairman of the Board of Directors of the Jones & Laughlin Steel Corporation, died at his home in Pittsburgh, Jan. 1 in his sixtieth year, after an illness of less than two weeks. The corporation which he controlled was founded by his father, the late B. F. Jones, more than three-quarters of a century ago, and it remains unaffected by the combinations and consolidations of the last 25 years. Immediately after his graduation from college in 1891, Mr. Jones entered the employ of Jones & Laughlin, Ltd., as the company was then known, becoming treasurer and a member of the Board of Managers. Four years before the death of his father he became president. When the Jones & Laughlin Steel Corporation was formed in 1923 he became chairman.

Personal Mention

Frank D. Comerford has been elected president of the New England Power Association.

H. J. B. Scharnberg was elected vice-president of the section of engineering at the annual meeting of the Asociacion de Tecnicos Azucarera de Cuba.

A. H. Manwaring, electrical engineer with the Philadelphia Electric Company, in charge of transmission and distribution, has resigned.

Andrew C. Erwin, has been elected to the board of directors of the Georgia Power Company. Mr. Erwin succeeds the late J. Billups Phinizy, of Athens, Ga.

Thomas Finnerty, for more than ten years manager of the Otter Tail Power Company's plant at Langdon, N. D., has resigned to make his home on the West Coast.

Renzo Norsa, managing director of the Compagnia Generale di Elettricita, Italy, sailed for Europe recently, having spent six weeks in this country studying general electrical conditions.

George W. Hawkins is now assistant to the president of the Worthington Pump & Machinery Corporation, New York City. Mr. Hawkins was formerly general manager of the industrial department of the Vacuum Oil Company, Chicago.

W. J. Canada has been appointed managing director of the engineering division of the National Electrical Manufacturers Association. Mr. Can-

ada served for four years as engineering director of the National Electric Light Association.

W. J. THORP has resigned his association with the Arkansas Power & Light Company. Mr. Thorp has been affiliated with the electrical industry in Little Rock, Ark., for more than 28 years, serving on special committees of the National Electric Light Association.

Society Affairs

A.S.M.E. BUFFALO: January 17, Hotel Statler at 8:00 p.m. Subject: "The Arteries of Industry," motion picture films, National Tube Co. W. P. Wooldridge will lecture. There will also be shown a film on building New York's newest subway by the Dupont Company.

A.I.E.E., CLEVELAND SECTION meeting at Hotel Statler, 8 o'clock, Jan. 19; "Today's Science, Tomorrow's Engineering," by L. A. Hawkins, General Electric Company.

A.S.M.E. and A.I.E.E. NEW YORK SECTION meeting at 29 West 39th St., New York City, 8 o'clock, Jan. 13, "Interconnection of Power Systems," Alex Dow, president of Detroit Edison Company, and Farley Osgood, consulting engineer.

A.S.M.E., POWER DIVISION meeting at 29 West 39th St., New York City, 8 o'clock, Jan. 30; "What Is the Limiting Temperature in Central Station Operation?", V. T. Malcom, metallurgical engineer, Chapman Valve Manufacturing Company; A. M. Keenan, assistant engineering manager, Thomas E. Murray, Inc.

Business Notes

THE WATTS REGULATOR COMPANY, Lawrence, Mass., manufacturer of the Watts line of regulators, reducing and relief valves announces that Charles C. Phelps, 30 Church St., New York City, will handle sales in that territory.

THE HENDRICK MANUFACTURING COMPANY, Carbondale, Pa.; manufacturer of Mitco interlocked steel grating, Shur-Site stair threads and Armorgrids, announces the opening of a Chicago district office, 223 Railway Exchange Building, Chicago, in the charge of Lon Sloan.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, manufacturers of electric motor control apparatus, will handle Pacific Coast sales from new offices opened Jan. 1 at 970 Folsom St., San Francisco, 229 Boyd St., Los Angeles, and 2203 First Avenue, South, Seattle. The new sales district will be in charge of Fred H. Oberschmidt, and associated with Mr. Oberschmidt at the San Francisco headquarters office, A. A. Tuffert and George P. Stone. Thomas N. Bristow will be in charge of the Seattle office and Edward G. Nelson of the Los Angeles office.

THE NATIONAL CARBON COMPANY'S sales division with general sales headquarters at Cleveland, has announced the opening of branch sales offices to be located at the present Brush Service Plants of the company in New York City, Chicago, Pittsburgh, and Birmingham. The addresses of the newly established branch sales offices are as follows: 357 West 36th St., New York City, 551 West Monroe St., Chicago; Arrott Power Building No. 3, Barker Place, Pittsburgh, and 1824 Ninth Avenue, North Birmingham, Ala. J. A. Hammond will be assistant manager in charge of carbon brush and specialty sales at the headquarters office at Cleveland; and E. R. Geib, assistant manager in charge of sales of illuminating carbons. E. C. Friday will serve as district manager in charge of the branch office at New York City; J. L. Green in the same capacity at Chicago; V. J. Nolan, at Pittsburgh, and J. B. Collins, sales engineer in charge of the branch office at Birmingham.

Coming Conventions

American Boiler Manufacturers Association, winter meeting, Hotel Cleveland, Cleveland, Feb. 7; A. C. Baker, sec., 801 Rockefeller Bldg.

American Engineering Council, annual meeting will be held in Washington, D. C., Jan. 9-11; L. W. Wallace, executive secretary, 26 Jackson Place, N. W., Washington, D. C.

American Institute of Electrical Engineers, winter convention at New York City, Feb. 13-17, F. Hutchinson, secretary, 29 West 39th St., New York City; St. Louis Regional Meeting, District No. 7, March 7-9; Baltimore Regional Meeting, District No. 2, April 17-19; New Haven Regional Meeting, Northeastern District, No. 1, in May; Summer Convention, in Denver, June 25-29.

American Society of Heating & Ventilating Engineers, hold general meeting at Hotel Pennsylvania in New York City, Jan. 23-26; A. V. Hutchinson, sec., 29 W. 39th St., New York.

American Society of Mechanical Engineers, spring meeting in Pittsburgh, May 14-17; Calvin Rice, secretary, 29 West 39th St., New York City.

American Water Works Association. Annual meeting, Hotel Fairmont, San Francisco, June 11-16; W. M. Niesley, 170 Broadway, New York City.

Association of Iron and Steel Electrical Engineers, annual convention at Hotel Stevens, Chicago, June 25-29.

Midwest Power Conference and Exhibition, at Chicago, Feb. 14-17; G. E. Pfisterer, sec., 53 West Jackson Blvd., Chicago.

National Association of Stationary Engineers, annual convention at Detroit, Sept. 11; Fred Raven, 417 South Dearborn St., Chicago.

National Electric Light Association, Convention and exhibition, Atlantic City, N. J., June 4-8; A. Jackson Marshall, secretary, 420 Lexington Ave., New York City.

National District Heating Association, annual meeting at Ambassador Hotel, Atlantic City, June 12-15; D. J. Gaskill, sec., 112 West 4th St., Greenville, Ohio.

The National Marine Engineers' Beneficial Association, 53rd annual convention, will meet at the Lee House, 15th and L Streets, N. W., Washington, D. C., February 13-18. Albert L. Jones, Secretary-Treasurer, 313 Machinists Building, Washington, D. C.

Stoker Manufacturers Association, fall meeting at Greenbrier Hotel, White Sulphur Springs, W. Va., Oct. 22-24.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Jan. 5, 1928
Navy Standard	New York	$2.25@$2.75
Kanawha	Hampton Roads	1.63@ 1.88
Smokeless	Cincinnati	2.25@ 2.50
Smokeless	Chicago	2.25@ 2.50
S. E. Kentucky	Chicago	1.40@ 1.60
Steam	Pittsburgh	1.60@ 1.90
Gas Slack	Pittsburgh	1.15@ 1.35
Big Seam	Birmingham	2.00@ 2.25
Anthracite (Gross Tons)		
Buckwheat	New York	$2.85@$3.35
Birdseye	New York	1.60@ 1.85

FUEL OIL

New York—Jan. 5, light oil, tank-car lots, 24@26 deg. Baumé, 4¾c. per gal.; 28 deg., 5c. per gal., f.o.b. Bayonne, N. J.

St. Louis — Dec. 28, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.50 per bbl.; 26@28 deg., $1.55 per bbl.; 28@30 deg., $1.60 per bbl.; 30@32 deg., $1.65 per bbl.; 32@36 deg., gas oil, 4.3c per gal.; 38@40 deg., 5¼c. per gal.

Pittsburgh — Dec. 19, f.o.b. local refinery, 30@34 deg., fuel oil, 4½c. per gal.; 36@40 deg., 4¾c. per gal.

Philadelphia — Jan. 2, 26@30 deg., $2.00@$2.06 per bbl.; 13@19 deg., $1.26 @$1.32 per bbl.; 22 plus, $1.58@$1.64 per bbl.; 27@@30, $2.10@$2.16 per bbl.

Cincinnati — Jan. 2, tank-car lots f.o.b. local refinery, 24@26 deg. Baumé, 4.9c. per gal.; 26@30 deg., 5.15c. per gal.; 30@32 deg., 5½c. per gal.

Chicago—Dec. 17, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.; 22@26 deg., 80@85c. per bbl.; 26@30 deg., 90c. per bbl.; 30@32 deg., $1.05 per bbl.

Boston—Dec. 27, tank-car lots, f.o.b., 12@14 deg. Baumé, 4¼c. per gal.; 28@ 32 deg., 5¾c. per gal.

Dallas—Dec. 31, f.o.b. local refinery, 26@30 deg., $1.45 per bbl.

CENTRIFUGAL AIR COMPRESSORS—In Bulletin GEA-528A the General Electric Company treats of small multi-stage centrifugal air compressors, as part of a complete line of centrifugal air compressors or blowers, ranging in volume from 250 to 75,000 cu.ft. per minute and 0.75 to 30-lb. pressure. These small multi-stage units are rated at 250 to 700 cu.ft. per minute, and 0.75 to 4.0-lb. pressure.

CHAIN GRATE STOKERS—The McClave-Brooks Company, Scranton, Pa., gives a thorough description of the McClave bituminous chain grate stoker, natural and forced draft, for all grades of bituminous and lignite fuels, in a profusely illustrated catalog recently issued. New features of this stoker, listed, include renewable links, mechanical sifting removers, and new designs of spur gear and ratchet which are interchangeable on both the natural and forced draft stokers.

SPEED REDUCERS—In Bulletin A the Albaugh-Dover Manufacturing Company, Chicago, describes types "CA" and "CC" spur gear reducers, and types "A," "AB," "AC" and "AD" worm-gear reducers, type "B" combined worm and spur gear speed reducers, and type "BBB" worm and spur gear reducers. All these types are illustrated, as are also a number of accessories, and accompanied by tables of respective dimensions.

RADIANT HEAT FROM AIR FLOATED PULVERIZED COAL—Application of powdered coal to steam boilers, cement kilns, dryers, metallurgical and chemical work, and the results obtained with the air swept tube mill and carbureted fuel, is the subject of Bulletin No. 12 now issued by the Kennedy-VanSaun Manufacturing Corporation, 50 Church St., New York City. Charts of performance and installations of equipment are included in the bulletin.

DOMESTIC DEAËRATORS — Methods for investigating the causes of corrosion of piping, boilers, economizers and steam lines are described in Bulletin No. 675, issued by the Cochrane Corporation, Philadelphia. It is stated that with the increasing use of water purifying equipment, such as zeolite softeners and evaporators, corrosion in piping systems and heating apparatus has been intensified and is found in many places formerly free from it. The reason for this, the bulletin states, is that when scale-forming matter has been removed from the water nothing remains to protect the iron. After describing methods for making corrosion surveys, the bulletin discusses methods for preventing oxygen corrosion. Drawings are presented to show various deaërating heater arrangements, as installed to protect piping and boilers in heating systems, industrial plants, etc.

FILTRATORS — Filtrators Company, Inc., 96 Liberty St., New York City, describes this apparatus, which prevents the formation of scale in steam boilers. The Filtrator consists of an outer cast-iron cylinder, and an inner perforated cylinder containing ordinary flaxseed. Live steam from the boiler is piped in directly, permeates the flaxseed, condenses and extracts from it a mucilage producing the filtration emulsion which is introduced into the feed water through a regulating trap, and mixing, coats all particles, preventing them from adhering to the surface of the boiler and forming scale.

NEW PLANT CONSTRUCTION

Ark., Texarkana — E. M. Tucker, 1164 Railway Exchange Bldg., St. Louis, Mo., Archt., will receive bids until Jan. 18 for a union railroad depot here for Missouri Pacific R.R. Co., Texas & Pacific Ry. Co., St. Louis Southwestern Ry. Co. and Kansas City Southern Ry. Co. Estimated cost $1,700,000.

Calif., Chula Vista — Imperial Linen Products Corp., 413 Commonwealth Bldg., San Diego, awarded contract for the construction of a textile plant including 30 x 40 ft. boiler house, etc., here, to Hamm, Grant & Bruner, 607 Ferguson Bldg., Los Angeles. Estimated cost $60,000.

Calif., Los Angeles — Los Angeles Bar Assn., plans the construction of a 12 story office building including elevators, etc., at Flower St. between 6th and 7th Sts. Estimated cost $1,000,000. Allison & Allison, 1005 Hibernian Bldg., are architects.

Calif., Los Angeles—Lydia Morehouse, 692 South Berendo St., is having sketches made for a 12 story hotel including steam heating system, elevators, etc., at 7th and Berendo Sts. Estimated cost $650,000. R. M. Bates, Jr., 660 South Vermont Ave., is architect.

Calif., San Bernardino — John McKeon, E. J. Boescke & Associates, are having plans prepared for the construction of a theatre and office building at Court St. between D St. and Arrowhead Ave. Estimated cost $500,000. L. A. Smith, Filon Exchange Bldg., Los Angeles, is architect. West Coast Theatres, lessee.

D. C., Washington—MacKenzie, Voorhees & Gmelin, 1325 H St., N.W., Archts., will soon award contract for the construction of a telephone building, for Chesapeake & Potomac Telephone Co., 723 13th St. N. W. Estimated cost $800,000.

D. C., Washington—Wardman Construction Co., 1437 K St. N.W., is having plans prepared for the construction of a 13 story apartment building at 1018 Connecticut Ave. N.W. Estimated cost $1,300,000.

Ill., Chicago — J. I. Farwell, c/o P. E. Maher, 157 East Erie St., Archt., is having sketches made for a 13 story office and stores building at Dearborn and Illinois Sts. Estimated cost $500,000.

Ill., Chicago—Lutheran Memorial Hospital, 1116 North Kedzie Ave., is having sketches made for a 6 story addition to hospital at Kedzie and Haddon Aves. Estimated cost $750,000. Pond, Pond, Martin & Lloyd, 6 North Michigan Ave., are architects.

Ill., Chicago—A. W. Swayne, 410 North Michigan Ave., is having plans prepared for first unit of co-operative apartment building, 22 story at Melrose Ave. and Lake Shore Dr. Estimated cost $1,000,000. Holabird & Roche, 104 South Michigan Ave., are architects.

Ill., Evanston—Hall, Lawrence, Rippel & Ratcliffe, 123 West Madison St., Archts., will soon receive bids for a 7 story apartment building, including swimming pool, elevators, etc., at Hinman and Grove Aves., for H. S. Jones, 1428 Noyes St. Estimated cost $1,100,000.

Ill., Wilmette—D. H. Burnham & Co., 160 North La Salle St., Chicago, Archts., will soon receive bids for a club house at Michigan and Lake Aves., here, for Shawnee Country Club. Estimated cost $700,000.

Ind., Hammond — L. E. Deutsch, 1545 West 5th St., Gary, is receiving bids for the construction of a 5 story hotel including steam heating and mechanical refrigeration systems, elevators, etc., here. Estimated cost $550,000. L. H. Warringer, 673 Broadway, Gary, is architect.

Kan., Atchison—Kansas Power & Light Co., 14th St. and Grand Ave., Kansas City, Mo., plans to remodel ice plant here. Estimated cost $75,000. Work will be done by day labor.

Kan., Manhattan—Kansas State Agricultural College awarded contract for the construction of a power plant, to M. J. Green. Estimated cost $325,000.

Ky., Louisville—Baltimore Development Co., H. Platoff, Pres., c/o Platoff & Bush, plans the construction of an 11 story apartment building at Bonneycastle Ave. and Spring Dr. Estimated cost $800,000. Joseph & Joseph, Francis Bldg., are architects.

La., Monroe—Bastrop Ice & Storage Co., awarded contract for addition to ice and cold storage plant to double present capacity to J. W. O'Bryan. Estimated cost $40,000.

Mass., Boston—New England Building Inc., C. B. Wetmore, Pres., 260 Tremont St., is having preliminary plans prepared for a 22 story office and stores building at Stuart, Berkley Sts. and St. James Ave. Estimated cost $20,000,000. Blackall, Clapp & Whittemore, 31 West St., are architects. Fay, Spofford & Thorndike, 44 School St., are engineers. United Department Stores, Inc., 260 Tremont St., is lessee.

Mass., Boston—Sears, Roebuck & Co., Arlington and Homan Sts., Chicago, Ill., awarded contract for a retail store and mail order house at Brookline Ave. and Audubon Rd., to Hegeman-Harris Co., 100 Milk St., Boston, Mass. Estimated cost $4,000,000 to $5,000,000.

Mass., Lynn—Lynn Gas & Electric Co., E. B. Frazer, 90 Exchange St., awarded contract for the substructure of a boiler house to R. E. Runels Construction Co., 260 Tremont St., Boston. Estimated cost $40,000.

Mass., Newton (Boston P. O.) — New England Concrete Pipe Co., 79 Milk St., Boston, will build a power house on Needham St. here. Estimated cost $75,000.

Mass., Springfield—Seventy Chestnut St. Corp., 70 Chestnut St., awarded contract for the construction of a hotel to E. J. Pinney Inc., 220 Dwight St. Estimated cost $1,000,000.

Minn., Benson—City is having plans prepared for the construction of a new electric power plant and distribution system. A. L. Mullergren, 555 Gates Bldg., Kansas City, Mo., is engineer.

Minn., Rochester—Bd. of Education plans an election Jan. 18 to vote $200,000 bonds for the construction of a heating plant for high school.

Mo., Kansas City—McCandless Building Co., Victor Bldg., is having preliminary plans prepared for the construction of a

hotel at 300 East Armour St. Estimated cost $700,000. Private plans.

Mo., St. Louis—Stix, Baer & Fuller Dry Goods Co., Sixth St. Washington Ave., awarded contract for the construction of a 6 story commercial building on Laclede Ave. to Boaz-Kiel Construction Co., Ambassador Bldg. Estimated cost $750,000. Steam heating system, etc. will be installed.

N. J., Newark—Morris Tzesis, 46 Bock Ave., had plans prepared for a 12 story apartment, including steam heating and refrigeration systems, boilers, elevators, etc., at Johnson Ave. Estimated cost $750,000. H. F. Clark, 38 Clinton St., is architect.

N. Y., Conklingville—Hudson River Regulating Comn., 44 Howard St., Albany, awarded contract for the construction of Conklingville dam to impound the Scandaga reservoir to S. J. Groves & Son, 306 Globe Bldg., Minneapolis, Minn. Estimated cost $1,307,086.

N. Y., Hempstead — Corp., c/o W. B. Wills & Son, 852 Monroe St., Brooklyn, will build a 6 story apartment on Cathedral Ave. Estimated cost $550,000. Work will be done by separate contracts.

N. Y., New York — Broadway Improvement Corp., 30 Pine St., is having plans prepared for a 20 story office building at Broadway and 14th St. Estimated cost $700,000. E. Roth, 1440 Broadway, is architect.

N. Y., New York—Corporation, c/o W. L. Bottomley, 112 East 55th St., Archt., awarded contract for the construction of a 14 story co-operative apartment building at 93 East End Ave. to Whitney Co. Inc., 101 Park Ave. Estimated cost $600,000.

N. Y., New York—Corporation, c/o A. E. Lefcourt, 1351 Broadway, plans the construction of a 28 story hotel at 47th St. and Broadway. Estimated cost $4,250,000. Architect not selected. Work will be done by separate contracts.

N. Y., New York—Dominion Realty Corp., I. Polstein, Pres., 285 Madison Ave., will build a 15 story apartment at 186 Riverside Dr. Estimated cost $650,000. E. Roth, 1440 Broadway, is architect. Work will be done by separate contracts.

N. Y., New York—I. Feldman, 300 Madison Ave., will build a 15 story apartment at 325 East 79th St. Estimated cost $900,000. Gronenberg & Leuchtag, 1385 Broadway, are architects. Work will be done by separate contracts.

N. Y., New York—Ten East Ninety-Six Street Corp., c/o A. D'Antona, 100 West 72nd St., had plans prepared for a 15 story apartment building. Estimated cost $550,000. Rosario Candela, 578 Madison Ave., is architect.

O., Cincinnati—Dept. of Welfare, J. E. Harper, Dir., Ninth and Oak Sts., Columbus, will receive bids until Jan. 20 for waterworks improvements, including drilling of five wells, pumping station, etc. Estimated cost $25,000. R. H. Briggs, Ohio-Hartman Bldg., Columbus, is engineer.

O., Youngstown—Central Saving & Loan Co., 1 West Federal St., plans the construction of a 12 story bank and office building at Central Sq. Estimated cost $1,000,000.

Pa., Mayview—Dept. of Public Welfare, Pittsburgh, will soon award contract for additions to Pittsburgh City Home and Hospital, here. Estimated cost $1,500,000. Eric Fisher Wood Co., Hardy Hayes Bldg., Pittsburgh, is architect.

Tex., Brownwood — Brownwood Ice & Fuel Co., J. G. Lee, Mgr., will soon receive bids for the construction of an ice plant, 100 ton daily capacity. Estimated cost $50,000.

Tex., Brownwood — Morgan Utilities Corp., M. B. Morgan, Pres., is receiving bids for the construction of a 60 ton ice plant. Estimated cost $100,000. Private plans.

Tex., Carrizo Springs—City, c/o B. L. Jeffrey, will soon receive bids for waterworks improvements including well, pumping plant, etc. F. J. Von Zuben, Dan Waggoner Bldg., Fort Worth, is engineer.

Tex., El Paso—C. N. Bassett & Associates, will receive bids about Feb. 1 for the construction of a 12 story hotel including steam heating system, boilers, elevators, etc. Estimated cost $1,500,000. Trost & Trost, Two Republic Bldg., are architects.

Tex., Laredo—Santiago Pappas, is receiving bids for the construction of waterworks and distribution systems probably including pumping unit, etc. at San Bernardo, near here. Estimated cost $30,000. Private plans.

Tex., Midland—City plans an election soon to vote $110,000 bonds waterworks improvements including pumping equipment, etc. Montgomery & Ward, 544 Harvey Snider Bldg., Wichita Falls, are engineers.

Tex., Midland—W. C. Hedrick Inc., 1005 First National Bank Bldg., Fort Worth, Archt., will soon receive bids for a 10 story petroleum building for S. T. Hogan. Estimated cost $700,000.

Tex., Port Arthur—City plans an election soon to vote $20,000 for waterworks improvements including pumping equipment, etc. W. O. Bower, is city engineer.

Tex., San Antonio—San Antonio Public Service Co., E. H. Kifer, Gen. Mgr., 201 North St. Marys St., plans improvements to electric system including sub-stations, etc. Estimated cost $700,000. Private plans.

Tex., San Antonio — Woods Property Corp., H. C. Wood, Travis Bldg., has acquired a site and plans the construction of a 10 story apartment building. Estimated cost $500,000. Architect not selected.

Tex., Victoria—Central Power & Light Co., Frost Bldg., San Antonio, will build additions to power plant to increase the capacity. Estimated cost $100,000. Machinery and equipment will be required.

Va., Richmond—Richmond Hotels Inc., L. Paschall, V. Pres., is having plans prepared for the construction of a hotel. Estimated cost $2,500,000. M. E. Wright, American National Bank Bldg., is architect.

Ont., Ottawa—Norhite Realty Co. Ltd., Sparks and Kent Sts., is having plans prepared for a new office building on Wellington St. Estimated cost $800,000. Architect not seleced.

Ont., Ottawa—Wellington Investment Co., 128 Wellington St., awarded contract for a 10 story office building to Alex Garvoch Regent Theatre. Estimated cost $600,000. Steam heating system, elevators, etc. will be installed.

Ont., Toronto—Farmers Dairy Co., Walmer Rd. and Bridgeman Ave., awarded contract for the construction of a dairy including cold storage plant, etc. to Jackson Lewis Construction Co., Federal Bldg. Estimated cost $150,000.

Equipment Wanted

Boilers and Coal Handling Equipment—Bd. of Education, Pontiac, Mich., plans to purchase boilers and coal handling equipment for proposed central heating plant. Estimated cost $370,000.

Engines—Texas Central Power Co., Frost Bldg., San Antonio, Tex., plans to expend $40,000 for equipment including oil engines for proposed power plant at Brownsville, Tex.

Ice Plant Equipment—Kansas Power & Light Co., 14th St. and Grand Ave., Kansas City, Mo., plans to purchase new electrical machinery and equipment for remodeling of ice plant at Atchison, Kan.

Ice Plant Equipment—Texas Ice Co., A. J. Zilker, Fredericksburg Rd., San Antonio, Tex., prices and catalogs on machinery and equipment for proposed 60 ton ice plant, cost $70,000.

Loading and Unloading Equipment — Nueces County, N. Benton, Judge, Corpus Christi, Tex., plans to purchase loading and unloading equipment for proposed port improvements. Estimated cost $1,500,000.

Motors—Therian Bros. Ltd., 509 Gasford St., Montreal, Que., plans to purchase eight 12 hp. electric motors.

Power Plant Equipment—Penal Institutions Dept., Boston, Mass., will readvertise for bids for machinery and equipment for proposed power and heating plant at Deer Island, Boston Harbor, Mass. Former bids rejected.

Pumping Equipment—Central Power & Light Co., E. B. Neiswanger, Frost Bldg., San Antonio, Tex., plans to purchase pumping equipment, etc., for proposed waterworks improvements at Laredo, Tex. Estimated cost $33,000.

Pumping Equipment — City of Alpine, Tex., will soon receive bids for pumping equipment, etc., for proposed waterworks improvements, estimated cost $20,000.

Pumping Units—J. D. Elliott, mayor, Hickory, N. C., will receive bids until Jan. 18 for two motor driven and one gasoline engine driven centrifugal pumping units, etc. for proposed waterworks improvements.

Pumps—R. M. Clark, Miners Bank Bldg., Joplin, Mo., is receiving bids for pumps for proposed irrigation project, near San Benito, Tex., estimated cost $18,000.

Pumps, etc.—City of Mooreland, Okla., plans to purchase pumps, etc., for proposed waterworks improvements. Estimated cost $65,000.

Pumps, Motors, Engines, Etc. — Bd. of Levee Comrs. of Yazoo-Mississippi Delta, Clarksdale, Miss., will receive bids until Feb. 1 for one 50,000 g.p.m. motor driven or oil engine driven pump with Diesel engines and electric motors for proposed drainage pumping plant.

Regulator, Switchgear, Etc. — Dept. of Public Works, Supplies and Tenders Board, Wellington, N. Z., will receive bids until Jan. 24 for outdoor type automatic voltage regulator for the Waikaremoana electric power scheme. Also until March 27 for an 11,000 v. switchgear for Lake Coleridge electric power scheme.

POWER *Information Bureau*

Your machinery, equipment, and materials requirements will be noted *free of charge* in the New Plant Construction section of POWER.

Use the Coupon to make your requirements known

A. W. WELCH
Power Equipment Information Bureau
Tenth Ave. at 36th St., New York, N. Y

In the market for.....

Name .....

Company or Plant.....

Address .....

PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

PRICES of power-plant supplies show a great excess of advances over declines, comparing current levels with those of a month ago. Steam hose discounts are lower; air hose prices rose, since December. Smaller discounts are being granted on rubber belting; leather belting discounts hold. Current prices on belt lacing, as shown in the table, are minimum. There is continued firmness in magnesia pipe and boiler covering. Maximum on white, wiping cloths is about ½c. per lb. above last month's figure. Linseed oil is off 7c. per 7½ lb. gal. at Chicago. Cold drawn steel declined 70c. per 100 lb. at New York warehouses.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2½-in., coupled, single jacket		(net) 68c. per ft.
Common, 2½-in., cotton-rubber lined	80c. per ft. list, less	50%

Air—Best grade

	3-ply	4 ply
¾-in., per ft.	$0.36½	$0.44

Steam—Discounts from List

First grade....30–10% Second grade....40% Third grade....45%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. The following discounts from list apply to rubber transmission belting:

Best grade.... 45% Second grade.... 50%

LEATHER BELTING—List price, 24c., per lin.ft. per inch of width, for single ply, at New York warehouses:

Grade	Discount from list
Medium	35%
Heavy	30%

RAWHIDE LACING—For cut, best grade, 30–10%; 2nd grade, 50–10%. For laces in sides, best, 46c. per sq.ft.; 2nd, 42c. Semi-tanned, cut, 30–10%.

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ¼ in	$0.95
Asbestos for high-pressure steam, ½ in.	1.75
Duck and rubber for piston packing	.95
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.85
Wire insertion asbestos sheet	1.30
Rubber sheet	.50
Rubber sheet, wire insertion	.80
Rubber sheet, duck insertion	.60
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ¼- and 1-lb. balls	.50

PIPE AND BOILER COVERING—Discounts, New York warehouses, are as follows:

85% magnesia high pressure		50%
Asbestos, air cell, for low-pressure heating and return lines	4-ply	70%
	3-ply	72%
	2-ply	74%

PORTLAND CEMENT—New York, $2.25@2.35 per bbl. without bags, in carload lots, delivered by truck to site of job. Bag charge, 40c. per bbl.

STRUCTURAL STEEL—New York delivered price, beams and channels, 3 to 15-in.; angles, 3 to 6-in., ¼-in. thick; tees, 3-in. and larger; and plates, ¼-in. thick and heavier; all $3.34 per 100 lb.

COTTON WASTE—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	10.00@13.50	16.00	15.00@20.00
Colored	9.00@13.00	12.00	12.00@17.00

WIPING CLOTHS—Prices per pound in lots of about 600 lb., for washed, white wipers, as follows:

Chicago	$0.15
New York	.15½@.18
Cleveland (*per thousand*)	$6.00

LINSEED OIL—These prices are per 7½-lb. gallon:

	New York	Cleveland	Chicago
Raw in barrels (5 bbl. lots)	$0.79½	$0.89	$0.76

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry		In Oil	
	Current	1 Yr. Ago	Current	1 Yr. Ago
Red	$13.75	$15.25	$15.25	$16.75
White	13.75	15.25	13.75	15.25

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

Tank rivets, small, including ⅝-in. dia., list (Apr. 1, 1927) less 50-10% in full keg lots, for immdeiate delivery from warehouse stocks in New York and vicinity.

Structural rivets, per 100 lb.:
New York.... $5.00* Chicago... $3.60 Pittsburgh mill $2.75@$3.00

Cone-head boiler rivets, per 100 lb.:
New York.... $5.00* Chicago... $3.60 Pittsburgh mill.... $3.00

*Price is for full keg lots; broken keg lots, $6.50 net.

REFRACTORIES—Prices in car-load lots, f.o.b. plant:

Chrome brick, eastern shipping points	per net ton	$45.00
Chrome cement, 40@50% Cr_2O_3, in bulk	per net ton	22@25
Chrome cement, 40@50% Cr_2O_3, in sacks	per net ton	26@29
Magnesite brick, 9-in. straights	per net ton	65.00
Magnesite brick, 9-in. arches, wedges and keys	per net ton	71.50
Magnesite brick, Soaps and splits	per net ton	91.00
Silica brick, Mt. Union, Pa.	per M	43.00
Clay brick, 1st quality, 9 in. shapes, Pennsylvania	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Maryland	per M	43@46
Clay brick, 2nd quality, 9 in. shapes, Pennsylvania	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Maryland	per M	35@38
Chrome ore crude, 40@50%	per net ton	18.00@22.50

BABBITT METAL—Delivered, New York, cents per lb.:

Genuine, highest grade	76.00
Commercial genuine, intermediate grade	61.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	12.50

COLD DRAWN STEEL—Warehouse prices per 100 lb., base, are as follows:

	New York	Cleveland	Chicago
Shafting and screw stock, round and hexagon	$3.30	$3.65	$3.60
Flats and squares	3.80	4.15	4.10

BOILER FITTINGS—F. o. b. New York or Jersey City, discounts from list:

	Current
Copper ferrules	70%
Boiler flanges	65-5%
Boiler stay bolts	60%
Boiler patch bolts	20%
Boiler fitting-up bolts	45%
Pressed steel boiler lugs	10%

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

	Steel			Iron	
Inches	Black	Galv.	Inches	Black	Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 and 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

BOILER TUBES—Following are net prices per 100 ft. at New York warehouse on tubes manufactured according to specifications of the American Society of Mechanical Engineers:

Size	Lapweld Steel	C. C. Iron	Seamless Steel
1	.....	.....	$17.07
1¼	.....	.....	19.20
1½	.....	$38.00	17.92
1¾	.....	28.50	20.48
2	$17.33	25.00	20.24
2¼	19.84	28.25	23.00
2½	21.60	34.00	26.03
3	25.50	42.50	27.04
3½	30.25	49.50	30.67
3½	31.50	52.75	33.33
4	38.03	67.00	40.11

Tubes 2½ in. diameter, or smaller, over 18 ft. long, 10 per cent extra.
These prices are net per 100 ft. based on stock lengths. If cut to special lengths, billing will be based on the entire stock lengths.
In addition to the above, standard cutting charges are as follows:
2 in. and smaller.. 5c. per cut. 3 in..... 9c. per cut.
2¼ and 2½ in..... 6c. per cut. 3¼ to 4 in.... 10c. per cut.

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft.—5 per cent. 10 days.

B. & S. Size	Two Cond. M Ft.	Three Cond. M Ft.	Two Cond. Lead M Ft.	Three Cond. Lead M Ft
No. 14 solid	$30.00 (net)	$46.00 (net)	$180.00	$220.00
No. 12 solid	136.00	180.00	225.00	275.00
No. 10 solid	185.00	235.00	275.00	325.00
No. 8 stranded	305.00	375.00	420.00	500.00
No. 6 stranded	440.00	530.00	615.00	.....

From the above lists discounts are:	Lead Covered
Less than coil lots..... 50%	20%
Coils to 1,000 ft..... 60%	30%
1,000 to 5,000 ft..... 65%	35%
5,000 ft. and over..... 67%	38%

CONDUIT—Price per 1,000 ft.; **ELBOWS AND COUPLINGS**, per 100 pieces, f.o.b. New York, with 10-day discount of 5 per cent.

Size In.	Conduit Black Per M	Conduit Galvanized Per M	Elbows Black Per C	Elbows Galvanized Per C	Couplings Black Per C	Couplings Galvanized Per C
¼	$56.50	$61.34	$7.76	$8.83	$4.52	$4.92
⅜	72.07	78.63	10.21	11.63	6.46	7.03
½	103.31	113.00	15.10	17.21	8.39	9.13
¾	139.77	152.88	20.51	23.07	11.78	12.75
1	167.12	182.79	27.34	30.76	14.56	15.75
1¼	224.85	245.94	50.13	56.40	19.41	21.01
1½	355.50	388.85	82.03	92.28	27.73	30.01
2	464.88	508.50	218.74	246.10	41.59	45.01
2½	585.30	637.74	483.04	543.46	55.46	60.02
3	714.17	776.30	558.23	628.06	69.32	75.02

CONDUIT BODIES AND FITTINGS—Black or galvanized.

	Less than $10 list	$10 list to $100	$100 list and over
Standard package	10%	20%	28%
Less than standard package	5%	10%	20%

CUT-OUTS—Following are net prices, each, in standard-package quantities:

CUT-OUTS, PLUG, SOLID, NEUTRAL OR 2-FUSE

S. P. M. L.	$0.12	D. P. D. B.	$0.31
D. P. M. L.	.16	T. P. S. B.	.35
T. P. M. L.	.27	T. P. D. B.	.47
D. P. S. B.	.16		

CUT-OUTS, N. E. C. FUSE, SOLID, NEUTRAL OR 2-FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.	$0.27	$0.70	$1.75
T. P. M. L.	.40	1.00	2.30
D. P. S. B.	.35	.87	.....
T. P. S. B.	.67	1.50	.....
D. P. D. B.	.65	1.75	.....
T. P. D. B.	1.12	3.00	.....
T. P. to D. P. D. B.	.75	2.10	.....

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy		$17.75
No. 16 cotton reinforced heavy		22.00
No. 18 cotton reinforced light		14.50
No. 16 cotton reinforced light		18.35
No. 18 cotton Canvasite cord		14.75
No. 16 cotton Canvasite cord		17.20
No. 16 super service cord or similar (2 wire) in 1,000 ft.	$72.00	*80.00
No. 14 super service cord or similar (2 wire) in 1,000 ft.	110.00	*122.00

*Less than 1,000 ft.

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List	600-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.15	3-amp. to 30-amp.,	100	$0.30
35-amp. to 60-amp.,	100	.30	35-amp. to 60-amp.,	100	.60
61-amp. to 100-amp.,	50	.90	65-amp. to 100-amp.,	50	1.50
101-amp. to 200-amp.,	25	2.00	110-amp. to 200-amp.,	25	2.50
201-amp. to 400-amp.,	25	3.60	225-amp. to 400-amp.,	25	5.50
401-amp. to 600-amp.,	10	5.50	450-amp. to 600-amp.,	10	8.00

Discount: Less than one-fifth standard package, 60%; one-fifth to standard package, 64%; standard package, 70%.

RENEWABLE FUSES—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.	$0.50	$1.10	100	10
35 to 60-amp.	1.00	1.25	100	10
65 to 100-amp.	2.00	3.00	50	5
110 to 200-amp.	4.00	5.00	25	5
225 to 400-amp.	7.50	11.00	25	1
450 to 600-amp.	11.00	16.00	10	1
REFILLS—				
1 to 30-amp.	$0.03 ea.	$0.05	100	100
35 to 60-amp.	.05 ea.	.06	100	100
65 to 100-amp.	.10 ea.	.10	50	50
110 to 200-amp.	.15 ea.	.15	25	50
225 to 400-amp.	.30 ea.	.30	25	25
450 to 600-amp.	.60 ea.	.60	10	10

Discount Without Contract—Fuses:	
Broken carton	5%
Unbroken carton but less than standard package	22%
Standard package	40%
Discount Without Contract—Renewals:	
Less than standard package	Net list
Standard package	40%
Discount With Contract—Fuses:	
Broken cartons	10%
Unbroken cartons but less than standard package	26%
Standard package	42%
Discount With Contract—Renewals:	
Less than standard package	Net list
Standard package	42%

FUSE PLUGS, MICA CAP—

0-30 ampere, standard package (500)	$2.50
0-30 ampere, less than standard package	2.80

LAMPS—Below are present quotations in less than standard package quantities on Mazda standard A type bulbs:

100—130 Volt			200—260 Volt		
Watts	Type	Price Each	Watts	Type	Price Each
15	A 17	$0.23	Special		
General			25	A 19	$0.28
25	A 19	.23	50	A 21	.28
40	A 21	.23	100	A 23	.50
50	A 21	.25			
60	A 21	.25			
100	A 23	.40			

Standard pkg. quantities are subject to discount of 10% from list. Annual contracts ranging from $75 to $300,000 net, allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain, separable, attachment plug	$0.18
Composition, 2-piece, attachment plug	.27
Swivel attachment plug	.12
Small size, 2-piece plug, composition	.07

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f. o. b. New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Solid Duplex
14	$6.00	$9.30	$10.90	$17.50
12	9.95	12.50	14.50	24.60
10	13.20	16.25	18.30	31.00
8	19.10	22.50	24.00	43.00
6	.....	.....	33.75	.....
4	.....	.....	47.50	.....
2	.....	.....	66.75	.....
1	.....	.....	92.00	.....
0	.....	.....	113.00	.....
00	.....	.....	134.50	.....
000	.....	.....	161.00	.....
0000	.....	.....	191.50	.....

SOCKETS, BRASS SHELL—Price each, net:

	⅛ In. or Pendant Cap			¼ In. Cap		
	Key	Keyless	Pull	Key	Keyless	Pull
Standard package.	$0.11	$0.11	$0.18	$0.16½	$0.15	$0.22
Unbroken carton..	.14	.13	.20	.18	.16	.23
Broken carton....	.16	.15	.22	.20	.18	.25

WIRING SUPPLIES—

Friction tape, ¾ in., less than 100 lb., 31c. per lb.	100 lb. lots	29c. per lb
Rubber tape, ¾ in., less than 100 lb., 33c. per lb.	100 lb. lots	31c. per lb
Wire solder, less than 100 lb., 33c. per lb.	100 lb. lots	31c. per lb
Soldering paste, 2 oz. cans		$1.00 doz

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c. or a.c., N.E.C.

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole Each
30	$4.50	$6.00	$7.25
60	7.50	8.25	10.50
100	10.50	13.00	22.50
200	16.00	20.00	36.00

Discounts:	
Less than $25.00 list value	30%
$25.00 to $50.00 list value	30-5%
$50.00 list value or over	35%